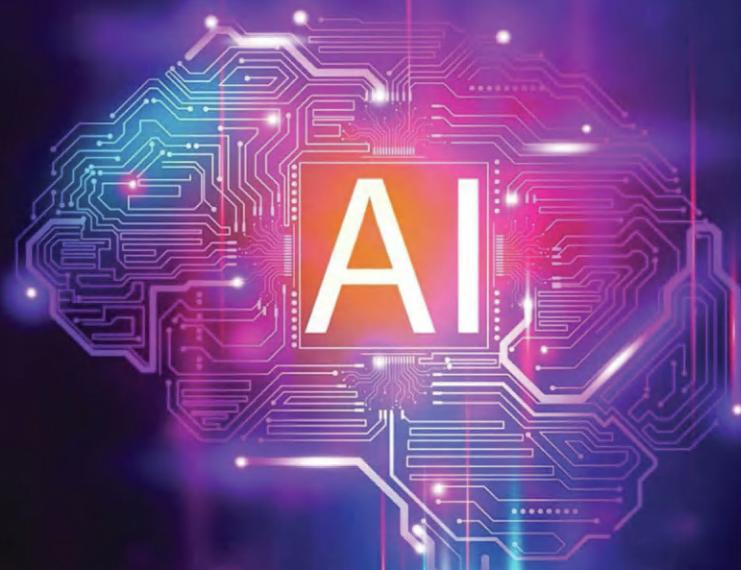


# Teaching and Learning in the Age of Generative AI

Evidence-Based Approaches to Pedagogy,  
Ethics, and Beyond

Edited by

Joseph Rene Corbeil and Maria Elena Corbeil



# Teaching and Learning in the Age of Generative AI

*Teaching and Learning in the Age of Generative AI* explores how educators can effectively harness the potential of artificial intelligence technologies while skillfully navigating its pedagogical, technical, ethical, institutional, and societal implications. The increasing accessibility of AI technologies among K-12 and higher education students has raised extensive concerns around academic integrity, though a deeper lineage of research and development suggests that these tools may be used to supplement instruction, prioritize critical thinking, and promote digital literacy. Bookended by in-depth analyses of the historical and future trajectories of artificial intelligence in education, this comprehensive resource provides evidence-based strategies for classroom implementation and helpful summaries of common benefits and risks. Teaching assistance, personalized learning, redefined assessments, anti-bias measures, and safeguards against misconduct and privacy infringement are among the wealth of topics addressed in these chapters. This book is an ideal text for undergraduate and graduate students of teacher education and curriculum and instruction as well as for higher education teaching faculty, school technology coordinators, and talent development personnel in training and in service.

**Joseph Rene Corbeil** is Professor of Educational Technology at The University of Texas Rio Grande Valley, USA.

**Maria Elena Corbeil** is Professor of Educational Technology at The University of Texas Rio Grande Valley, USA.



**Taylor & Francis**  
Taylor & Francis Group  
<http://taylorandfrancis.com>

# Teaching and Learning in the Age of Generative AI

Evidence-Based Approaches to  
Pedagogy, Ethics, and Beyond

Edited by

**JOSEPH RENE CORBEIL AND MARIA ELENA CORBEIL**

Designed cover image: © Getty Images

First published 2025  
by Routledge  
605 Third Avenue, New York, NY 10158

and by Routledge  
4 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

*Routledge is an imprint of the Taylor & Francis Group, an informa business*

© 2025 selection and editorial matter, Joseph Rene Corbeil and Maria Elena Corbeil;  
individual chapters, the contributors

The right of Joseph Rene Corbeil and Maria Elena Corbeil to be identified as the  
authors of the editorial material, and of the authors for their individual chapters,  
has been asserted in accordance with sections 77 and 78 of the Copyright,  
Designs and Patents Act 1988.

All rights reserved. No part of this book may be reprinted or reproduced or utilised  
in any form or by any electronic, mechanical, or other means, now known or  
hereafter invented, including photocopying and recording, or in any information  
storage or retrieval system, without permission in writing from the publishers.

*Trademark notice:* Product or corporate names may be trademarks or registered trademarks,  
and are used only for identification and explanation without intent to infringe.

ISBN: 978-1-032-68859-6 (hbk)  
ISBN: 978-1-032-68365-2 (pbk)  
ISBN: 978-1-032-68860-2 (ebk)

DOI: 10.4324/9781032688602

Typeset in Dante and Avenir  
by Newgen Publishing UK

# Contents

<i>About the Editors</i>	viii
<i>Contributor Biographies</i>	x
<i>Foreword</i>	xxi
<i>Badrul H. Khan</i>	
<i>Preface</i>	xxv
<b>Part I Foundations and Frameworks of AI in Education</b>	<b>1</b>
1 What Is Generative AI? A Primer <i>Maria Elena Corbeil</i>	3
2 Developing a Framework for Implementing AI in Education and Evaluating Its Use <i>Leticia De Leon</i>	19
<b>Part II Transformative Teaching and Learning with AI</b>	<b>47</b>
3 Transformative Teaching with AI <i>Karl M. Kapp, Jessica Briskin</i>	49

**vi** Contents

4 The Age of Chat: Education and the Rise of No-Code Chatbots <i>Jason Gulya</i>	77
5 Promoting Critical Thinking and Problem-Solving Through AI <i>Le Dinh Bao Quoc</i>	90
<b>Part III Ethical and Institutional Considerations</b>	<b>119</b>
6 Rethinking Cheating in the Age of AI <i>Clive Forrester</i>	121
7 Developing Institutional Policies for AI in Education <i>R. Joel Farrell II, Robin Gosdin Farrell, Jendia Grissett, Joni Winter, Amy Pridemore</i>	143
8 Navigating Risks: Inaccuracies, Bias, Disinformation, and Privacy in Educational AI <i>Krzysztof Walczak, Wojciech Cellary</i>	163
9 Exploring the Generative Artificial Intelligence Fair Use Policy Landscape in Higher Education <i>Francisco Garcia, Harriet E. Watkins</i>	195
<b>Part IV Preparing Educators and Students for AI Integration</b>	<b>211</b>
10 Teaching Generative AI in Higher Education: Strategies, Implications, and Reflective Practices <i>Andrew Kelly, Miriam Sullivan, Katrina Strampel</i>	213
11 Preparing Pre-Service and In-Service Teachers for the AI-Driven Classroom <i>Lucas Kohnke, Curtis Green-Eneix</i>	235
12 Preparing Students to Live and Work in an AI-Driven World: Ideas for Educators and Students <i>Laura Dumin</i>	253

<b>Part V Future Trends and Implications of AI in Education</b>	<b>281</b>
13 Redefining Assessments in the Age of AI <i>Debby R. E. Cotton, Lynne Wyness, Ben Jane, Pete A. Cotton</i>	283
14 AI and the Digital Divide <i>Renee Rottner, Lenore Porter, Jason Bock, Jordan Jannone, Rory Walsh Senerchia, Janet Ward, Joshuah Whittinghill</i>	309
15 Defining Key Workplace Competencies in the AI Era: A Framework for AI-Powered Education <i>Peter Cardon, Bryan Marshall</i>	332
16 AI-Driven Self-Directed Lifelong Learning: Personalization and Empowerment in the Digital Age <i>Didem Tufan, Elif Öztürk</i>	347
17 The Future of Learning: AI-Driven Education in 2040 <i>Joseph Rene Corbeil</i>	362
<i>Index</i>	391

# About the Editors

## **Joseph Rene Corbeil**

Dr. Joseph Rene Corbeil is a Professor of Educational Technology at The University of Texas Rio Grande Valley. He has been involved in technology and distance education for over 40 years. Research interests include institutional considerations for developing e-learning partnerships, best practices in synchronous and asynchronous communication, enhancing learning through just-in-time instructional and informational microlearning objects, and developing and maintaining learning team collaborations in computer-mediated learning environments. He is currently exploring the potential uses of virtual reality, augmented reality, and 3-D virtual environments for immersive individualized and collaborative e-learning. As an educator, Dr. Corbeil has earned several recognitions such as district Teacher of the Year, 2022 and 2019 Online Learning Consortium Excellence in Instructional and Teaching Practice awards, the 2021 UTRGV Faculty Excellence Award in Online Teaching, 2020 Computer Educator of the Year awarded by the International Association for Computer Information Systems, and The University of Texas 2018 Regents' Outstanding Teaching Award. Dr. Corbeil's contributions to scholarship have also been recognized with numerous awards, including four book awards, including the 2021 AECT DDL Distance Education Book Award and the 2019 AECT Outstanding Book Award (Systems Thinking & Change Division),

three effective practice awards from the Online Learning Consortium, and the 2011 *EDUCAUSE Quarterly* Contribution of the Year Award. In 2021, Dr. Corbeil co-authored a chapter titled “Establishing Trust in Artificial Intelligence in Education” for the book *Trust, Organizations and the Digital Economy*. Since the release of ChatGPT Dr. Corbeil has been exploring the possibilities, limitations, and risks of ChatGPT in education. When the university first became aware of the potentially disruptive threat of ChatGPT, Dr. Corbeil was among the first people contacted to help devise a response for the university.

## **Maria Elena Corbeil**

Dr. Maria Elena Corbeil is a Professor of Educational Technology at The University of Texas Rio Grande Valley with 20+ years of experience designing and teaching fully online undergraduate, graduate, and doctoral courses in Educational Technology, as well as mentoring online faculty. Her research interests include microlearning, responsible data mining, artificial intelligence, MOOCs, and digital pedagogy. Her commitment to excellence in online teaching and learning have been recognized with several awards, including the 2023 UTRGV Faculty Excellent Award in Online Teaching, three Online Learning Consortium Effective Practice Awards, and an AECT Best Practice Award. She also presents at international conferences and has numerous awards and publications she has co-authored on e-learning and the transformative potential of technology in education, including the 2021 AECT DDL Distance Education Book Award and the 2019 AECT Outstanding Book Award. In 2021, Dr. Corbeil co-authored a chapter titled “Establishing Trust in Artificial Intelligence in Education” for the book *Trust, Organizations and the Digital Economy*. Since the release of ChatGPT Dr. Corbeil has been exploring its potential in education. She has been cautiously observing how her students were using ChatGPT in their academic work and communications.

# Contributor Biographies

**Jason Bock** is the Director of Distance Education at AMDA College of the Performing Arts, where he is pioneering an online BFA program for the performing arts. Formerly, he was Director of Operations for the Center for Online and Extended Learning at Tiffin University, where he advanced the use of generative AI across the institution. Bock holds a BA from The Union Institute and University and an MEd from Tiffin University. He is a doctoral candidate in Instructional Design and Technology at the University of West Florida, focusing on online student engagement.

**Jessica Briskin** is an Associate Professor of Instructional Design and Technology at Commonwealth University, Bloomsburg, specializing in learning design and development. She teaches graduate courses that integrate AI tools to enhance both the learning experience and the instructional design process. As a published author, her research focuses on the transformative role of AI in creating efficient, scalable, and personalized learning environments that meet the ever-evolving needs of learners. Dr. Briskin also consults with government, academic, and corporate organizations, delivering AI-driven training solutions that foster innovation and improve learning outcomes.

**Peter Cardon** is a Professor of Business Communication and Warren Bennis Chair in Teaching Excellence at the University of Southern

California. He has researched the impact of artificial intelligence on business communication and teamwork for the past ten years. He also researches technology-mediated communication and cross-cultural communication.

**Wojciech Cellary** is a Professor at WSB Merito University in Poznan, Poland. Formerly, he worked at three other universities in Poland and six abroad. He has authored ten books, edited 17 books, and published over 160 articles. He has led numerous research projects, and has consulted for the Polish Ministries of Science, Education, Telecommunications, Interior, Administration, Digitization and Regional Development, Polish Parliament and Senate. He has been a main organizer of over 60 scientific conferences and a member of program committees of over 400. His current research interests include technologies of electronic business, e-governance, Industry 4.0, virtual reality, blockchain, and artificial intelligence.

**Debby R. E. Cotton** is Professor of Higher Education and Dean of Research and Knowledge Exchange at Plymouth Marjon University. She is a Principal Fellow of the UK Higher Education Academy (PFHEA), a National Teaching Fellow (NTF) and a member of the UK Office for Students' AI Expert panel. She gained her doctorate at Oxford University and has published over 70 articles on higher education teaching and learning. She is senior author on one of the most highly cited papers on ChatGPT and education in the world and is a popular invited speaker on AI and Education in the UK and internationally.

**Pete A. Cotton** is an Associate Professor of Ecology at the University of Plymouth. His DPhil from the University of Oxford focused on plant-hummingbird networks, and he has since worked largely on avian ecology, with occasional forays into the marine realm. Throughout his career, he has also published a number of papers on pedagogic issues, including the impact of ChatGPT on higher education. He is an invited author of a review paper for *Biology Letters* on AI and biological education. Media coverage of his AI and education work with Debby Cotton includes the *Washington Post* (US), the *Guardian* (UK) and *Nature News*.

**Leticia De Leon** is a Professor of Teaching and Learning at the University of Texas Rio Grande Valley. She has been an educator for

over 30 years. With her broad area of expertise being curriculum and instruction, she has over the years delved into immersive learning, digital pedagogy for student engagement, and online learning and motivation. She has also pivoted to consider how generative AI can influence those areas of interest, and how it may alter how student engagement occurs, and how assessments are redesigned.

**Laura Dumin** obtained her PhD in English from Oklahoma State University in 2010. She is a Professor in English and Technical Writing at the University of Central Oklahoma who has been exploring the impact of generative AI on writing classrooms. When she is not teaching, Laura works as a co-managing editor for the *Journal of Transformative Learning*, directs the Technical Writing BA, is the AI Coordinator at UCO, and served as a campus SoTL mentor.

**R. Joel Farrell II** serves as the Vice Provost of Institutional Effectiveness for Texas Tech University Health Sciences Center. As part of this role he serves as the Chief Data and Analytics Officer and co-leads Digital Strategy and Data Governance. Dr. Farrell has served in higher education leadership roles across private, state and federal institutions focused on integrated institutional effectiveness, planning, innovation, and technology. Previous positions include the Chief of Planning and Innovation, Chief of Institutional Analytics, Associate Provost for Student Support and Academic Services, and Director of Center for Assessment, Research, and Evaluation.

**Clive Forrester** has a PhD in applied linguistics and is an Associate Professor, Teaching, in the Department of English at the University of Waterloo. He teaches courses in linguistics, academic and technical writing, and Caribbean literature and culture. His research areas are forensic linguistics, discourse analysis, and writing studies.

**Francisco Garcia** is the Director of the Center for Online Learning and Teaching Technology and a faculty member of the Master's in Educational Technology Program in the College of Education & P-16 Integration at The University of Texas Rio Grande Valley (UTRGV). Dr. Garcia also leads and serves on a variety of distance education professional committees and organizations at the national and state levels,

contributing his expertise for the development of best practices and guidelines for online instruction. He has presented at numerous state, national, and international educational technologies conferences. He has a Doctor of Education in Curriculum & Instruction with a specialization in Educational Technology from The University of Texas Rio Grande Valley.

**Robin Gosdin Farrell** is a family nurse practitioner with over 34 years of experience in primary care, college health, women's health, and indigent care. As a nurse practitioner and doctor of nursing practice, she has also taught graduate programs for 15 years, most recently at Auburn University College of Nursing. Dr. Gosdin Farrell has been a podium and poster presenter on a variety of topics, recently focusing on obesity management, disaster training, and rural health. She has published several articles on student mentoring, COVID-19 precautions, college health topics including vaping, and reproductive health to name a few. Her research includes disaster training, various primary care health topics, utilization of AI in nursing undergraduate and graduate education as well as education, treatment, and resources for patients and diverse populations.

**Curtis Green-Eneix** is a Research Assistant Professor in the Department of English Language Education at The Education University of Hong Kong. His research focuses on equitable language education, identity and language ideologies, and teacher development and has been featured in *TESOL Journal*, *System*, and *English Today*.

**Jendia Grissett** is the Dean of Institutional Research, Assessment, and Effectiveness at the United States Naval Community College. With advanced degrees in Educational Leadership, Curriculum and Instruction, and Social Work, she has held significant leadership roles in higher education. Her previous work with the Department of the Air Force and civilian institutions included spearheading strategic planning, accreditation, and fostering collaboration to promote institutional effectiveness. She also led diversity and inclusion initiatives and played a key role in securing prestigious designations for educational institutions, emphasizing her dedication to academic and community excellence.

**Jason Gulya** is a Professor of English and Applied Media at Berkeley College. He teaches a wide variety of onsite and online courses related to writing, the humanities, and AI-powered communication. He also serves as a faculty member for the Institute on AI, Pedagogy, and Curriculum (managed by the American Association of Colleges and Universities), and as an AI consultant for many colleges and universities. He has trained thousands of faculty members on incorporating AI into the classroom. For his unique approach to generative AI, he has been featured in *Forbes* and *Business Insider*.

**Ben Jane** is a Senior Lecturer and Programme Leader for the MPH Public Health course at Plymouth Marjon University. His expertise spans health promotion, exercise for chronic health conditions, and digital pedagogy. Ben's recent work focuses on harnessing the potential of AI to enhance learning experiences and prepare students for a future where effective AI use will be a defining feature of the workplace.

**Jordan Jannone** is an Instructional Technologist and Designer for Distance Learning at California State University, Northridge. With over 20 years of experience in higher education and corporate learning, he specializes in instructional design, curriculum development, and on-the-job training. Previously, Jannone has worked in the technology sector with both startups and large companies like Amazon Logistics. He has held academic and staff roles at Hofstra University, New School University, Mt. Sierra College, Los Angeles Film School, and National University. Jannone holds an MFA from the American Film Institute Conservatory, and an MS in Educational and Instructional Technology from National University.

**Karl M. Kapp** is a Professor of Instructional Design and Technology at Commonwealth University, specializing in AI's role in learning and development. He teaches a graduate course on AI, and leads efforts to create digital avatars of instructors and AI-based branching scenarios. He also works on AI voice activated interactions like his presentation partner AI-Jane. He has also developed resources like his YouTube series, *How Artificial Intelligence Can Help an Instructional Designer*. Dr. Kapp has written AI-focused articles for ATD's *T&D Magazine*, published chapters on AI in training, and has presented at international conferences on the topic of AI in learning and development.

**Andrew Kelly** is the Manager, Learning Support at Edith Cowan University. He has published widely in the fields of artificial intelligence in education, academic language and learning, and student support. In addition to this work, Andrew also serves as the President of the Association for Academic Language and Learning.

**Badrul H. Khan** is an internationally recognized leader in e-learning and educational technology, known for coining the term “web-based instruction” and authoring the groundbreaking 1997 book, *Web-Based Instruction*, which helped shape the field of e-learning. He has authored numerous award-winning books, including *Managing E-Learning*, which is widely translated. Dr. Khan is a recipient of several prestigious awards, including induction into the USDLA Hall of Fame in 2015. He also founded GyanBahan, a lifelong competency-based learning platform, and continues to lead global e-learning initiatives through consulting, workshops, and keynote speeches. Learn more at [BadrulKhan.com](http://BadrulKhan.com).

**Lucas Kohnke** is a Senior Lecturer in the Department of English Language Education at The Education University of Hong Kong. Holding a doctoral degree from the University of Exeter, UK, his specialty is the professional development of English language teachers in integrating emerging technologies. He has contributed over 50 articles to leading journals, including *Educational Technology & Society*, *Education and Information Technologies*, *ReCALL*, *System*, and *RELC Journal*.

**Bryan Marshall** is a Professor of Information Systems at Georgia College. He has researched artificial intelligence and its impact on skill needs and development for the past ten years. He also researches student learning, financial literacy software, and e-commerce.

**Elif Öztürk** is an Assistant Professor in the Department of Educational Sciences, Middle East Technical University (METU). Currently, her research focuses on “how teachers and instructors utilize AI in their instructional practices.” Dr. Öztürk’s BS degree is in Science Education. She got an MS degree from Industrial Design at METU, where she merged her educational expertise with design thinking. Her PhD degree is from Texas A&M University, specializing in Educational

Technology. Her doctoral research explored “Adaptive Expertise and Contextualized Activities in Computer-Aided Instruction.” During her PhD, Dr. Öztürk worked as a Research Assistant on the “Virtual Environment for Learning Science” project, where she gained extensive experience in facilitating student-directed inquiry in virtual learning environments and analyzing virtual educational games.

**Lenore Porter** is an instructional designer with the Academic Technology Center at California State University, Fullerton. She supports faculty in adopting generative AI, providing professional development on its ethical integration in teaching and learning. Previously, Porter taught high school mathematics and led professional development in pedagogy and curriculum design. She earned her BA in Integrated Educational Studies from Chapman University, an MEd in Curriculum and Instruction from the University of Nevada, Las Vegas, and an MS in Instructional Design and Technology from California State University, Fullerton.

**Amy Pridemore** has taught in the primary care nurse practitioner program at Auburn University since 2023 and served as a family nurse practitioner in a rural health clinic serving family medicine/obstetrics patients since June 2020. Also, she is the lead advanced practice provider for Auburn University’s three clinic efforts that treat marginalized populations. Dr. Pridemore’s research efforts include utilizing artificial intelligence in patient care, maximizing appropriate AI use in academia, and using AI for maximizing resources in marginalized populations. She completed her Bachelor of Nursing from the University of South Alabama in 2009 and Master of Nursing and Doctor of Nursing Practice from Auburn University in 2020 and 2021.

**Le Dinh Bao Quoc** is an author, educational solutions provider, and an AIED expert, whose 20+ years of work has made a significant impact in the field of English language teaching in Vietnam. Holding a Doctor of Education degree, Dr. Quoc is the Founder and CEO of Pro.Ed Education Solutions, a leading consultancy company that specializes in educational solutions. His book *The Art and Science of ChatGPT in Education* is one of the world’s first books about ChatGPT’s impact on education. Dr. Quoc is acknowledged by LinkedIn as a Top Educational Leadership Voice in 2024.

**Renee Rottner** is an Associate Professor of Teaching in the Technology Management Department at University of California, Santa Barbara, where she integrates AI in undergraduate, masters, and doctoral courses in negotiation and management. Prior to UCSB, Rottner was on the faculty at New York University's Stern School of Business in the Management and Organizations department. Her research focuses on innovation, particularly how innovators can improve the development of new ideas and new firms. Rottner holds a BA from Eastern Michigan University, an MS in Management Science and Engineering from Stanford University, and a PhD in Management from UC Irvine.

**Katrina Strampel** is the Director of the Centre for Learning and Teaching at Edith Cowan University in Western Australia. She has been supporting and researching higher education assessment reform, curriculum design, and learning experience design for over 20 years in universities in Australia and Canada. Katrina's focus is on development and acknowledgement of evidence-informed teaching practices that positively impact student learning outcomes and sharing those with the wider higher education sector to support systematically improving university learning and teaching practices.

**Miriam Sullivan** is the Manager, Educational Integrity at Edith Cowan University. She has previously worked as a learning adviser and lecturer and has a strong focus on supporting students. Her research evaluates the effectiveness of university support and outreach, particularly with regards to generative artificial intelligence.

**Didem Tufan** is the Chief Operating Officer of an AI and marketing research company, where she applies her expertise in technology and leadership to create international projects, focusing on learning and technology. She earned a PhD from Middle East Technical University, focusing on online knowledge sharing and collaboration in networked learning environments, reflecting her passion for e-learning and corporate training. With extensive experience in corporate, governmental, and technology initiatives, Dr. Tufan has driven numerous projects in enterprise environments. Her research interests include AI, microlearning, and corporate learning and development, specifically how emerging technologies reshape educational and organizational growth.

**Krzysztof Walczak** is a Full Professor of Computer Science, Head of the Department of Information Technology, and Director of the Institute of Informatics and Quantitative Economics at the Poznań University of Economics and Business in Poland. His research interests cover virtual reality, multimedia systems, and artificial intelligence. He coordinated numerous research and industrial projects in these domains and served as an expert for many national and European agencies. He has authored or co-authored two books and over 150 research articles published in books, journals, and proceedings of international scientific conferences. He teaches advanced courses in multimedia systems and artificial intelligence.

**Rory Walsh Senerchia** is an Associate Dean and Professor at Johnson & Wales University's John Hazen White College of Arts & Sciences. Her research focuses on curriculum development in interdisciplinary studies and arts and sciences. Senerchia explores generational changes, bridge programs, and academic culture shock, while implementing interventions for academic acculturation. She has led initiatives in experiential learning and Universal Design for Learning, fostering inclusive classroom environments and promoting diversity, equity, and inclusion. Senerchia earned her BA in English Literature and MA in Comparative Literature and Cultural Studies from the University of Connecticut, and her PhD in Humanities from Salve Regina University.

**Janet Ward** is the Assistant Director of the Library and Professor of Computer Science at Limestone University. She is also a Reference Librarian at the University of South Carolina Upstate, and an Adjunct Professor at Spartanburg Community College in the Mechatronics Program. Her research interests include AI, human-computer interaction, and user experience design. Ward holds a Master of Library and Information Science from the University of South Carolina, and a BS in Computer Science Internet Management and Web Development from Limestone University, and a BS in Human Resource Management from Clemson University.

**Harriet E. Watkins** has extensive experience in adult education across both private and public sectors. Since 2018, she has been the Chief Academic Officer at Instructional Connections, supporting online education at colleges and universities. She also teaches at the University

of Texas at Rio Grande Valley. Previously, she directed online learning at the University of Arkansas System eVersity and managed academic partnership programs at the University of Texas at Arlington. Dr. Watkins is the immediate Past President of the Texas Digital Learning Association and holds an EdD in Distance Education from Regent University.

**Joshuah Whittinghill** is an Information Technology Consultant in the Teaching & Learning Program and a Lecturer in Multicultural Gender Studies at California State University, Chico. He has also served as an academic advisor, assessment coordinator for the Educational Opportunity Program, consultant to faculty for the First Year Experience program, and writing center coordinator. His research focuses on equity, diversity, inclusion, first-generation college students, social and emotional learning, and mood enhancement. Whittinghill holds a BA in Music, an MA in English, an MEd from CSU, Chico, and a Doctorate in Educational Leadership from the University of California, Davis.

**Joni Winter** has been an Assistant Clinical Professor in the primary care nurse practitioner program at Auburn University College of Nursing since December 2022. With over 23 years of diverse nursing experience, including flight medicine in rural areas, she has spent 15 years as a nurse practitioner (NP) serving underserved, rural, and disadvantaged populations. Her diverse practice areas include critical care, emergency medicine, urgent care, hospital medicine, surgical oncology, and cardiology/cardiothoracic surgery. Dr. Winter is dedicated to improving health outcomes through evidence-based practice and systems leadership. She has published a chapter in the *Emergency Nurses Association's Sheehy's Emergency Nursing: Principles and Practice* textbook. Some of her research focuses on student mentoring/success, cardiovascular health, and the use of artificial intelligence in clinical practice and nursing/NP education to enhance patient care, improve access to care, optimize resources in rural and marginalized communities, and create innovative educational experiences.

**Lynne Wyness** is an Associate Professor in Academic Development at Plymouth Marjon University, where she currently leads three Curriculum 2030 transformation projects—Assessment, Learning Design, and Pedagogic Principles. She also oversees the Pedagogic

## **xx** Contributor Biographies

Research and Research Management modules for early-career academics. With 15 years of teaching experience across different educational sectors, Lynne earned her PhD in Human Geography from the University of Exeter in 2012. Before joining Marjon, she spent five years as an Educational Developer at the University of Plymouth, helping hundreds of academics to improve their teaching, learning, and assessment practices.

# Foreword

*Badrul H. Khan*

Reflecting on my two-decade-long association with Drs. Maria Elena Corbeil and Joseph Rene Corbeil, I hold their professional achievements in the highest regard. Rene first distinguished himself to me as an exemplary student in the Master of Education in Educational Technology program at the University of Texas Brownsville in 1996, demonstrating an outstanding aptitude for the discipline. His dedication and intellectual curiosity were evident, prompting me to invite him to serve as my research assistant during the preparation of my award-winning book, *Web-Based Instruction*, published in 1997.

Since then, I have had the privilege of witnessing the professional trajectories of both Rene and Maria Elena. Our shared passion for advancing education through technology has fostered numerous fruitful collaborations, resulting in the co-editing of three award-winning books: *The MOOC Case Book* (2015), *Responsible Analytics and Data Mining in Education* (2018), and *Microlearning in the Digital Age* (2021). Their scholarly contributions have significantly enriched our understanding of technology's transformative role in education, and it has been a distinct honor to collaborate with them on these impactful projects.

Today, I am deeply honored to be entrusted with the task of writing the foreword for their latest work, *Teaching and Learning in the Age of Generative AI: Evidence-Based Approaches to Pedagogy, Ethics, and Beyond*.

This publication promises to be an invaluable resource for educators and policymakers, offering a comprehensive exploration of integrating AI into educational practices and navigating the ethical complexities that accompany this shift. Maria Elena and Rene's unwavering commitment to illuminating the intersection of education and technology is inspiring, and I am confident that this new book will serve as yet another landmark contribution to the field.

## Why You Should Read This Book

The rapid integration of artificial intelligence (AI) technologies into educational settings necessitates a comprehensive guide that addresses the multifaceted impact of AI on teaching and learning. *Teaching and Learning in the Age of Generative AI: Evidence-Based Approaches to Pedagogy, Ethics, and Beyond* serves as an essential resource for educators, policymakers, and stakeholders in both K-12 and higher education to navigate the complexities and harness the potential of AI in educational contexts.

This book explores the institutional, pedagogical, technical, ethical, and societal implications of adopting AI in education. Featuring contributions from eminent researchers and thought leaders in the fields of AI and education, it provides strategies for incorporating generative AI into classroom instruction, outlining both the advantages and potential risks. The goal is to equip educators with practical tools to prepare students for an AI-driven world.

## Relevance to K-12 Education

In K-12 education, AI tools have the potential to revolutionize personalized learning, support diverse student needs, and automate routine tasks, thereby freeing up teachers to focus on more meaningful interactions with students. However, with these advancements come significant challenges, such as ensuring equitable access, maintaining data privacy, and fostering critical thinking skills in an AI-driven world. This book provides a foundational understanding of AI, practical frameworks for implementation, and ethical guidelines needed for educators to responsibly integrate AI into their classrooms. By

doing so, it equips them to prepare the next generation of students for a future where AI literacy is as important as traditional literacy and numeracy skills.

### *Relevance to Higher Education*

In higher education, AI is poised to transform pedagogy, research, and administrative processes. From AI-driven personalized learning experiences and intelligent tutoring systems to the use of chatbots for student support, the potential applications are vast. However, the adoption of these technologies must be approached with caution, considering issues such as academic integrity, data security, and the ethical implications of AI in decision-making processes. This book addresses these concerns by offering evidence-based approaches to integrating AI in a way that enhances educational outcomes while upholding ethical standards. It also explores the need for new institutional policies and frameworks that support the responsible use of AI, preparing both faculty and students to thrive in an AI-enhanced academic environment.

### *Bridging the Gap*

One of the unique strengths of this book is its focus on bridging the gap between K-12 and higher education. By providing insights into how AI can be used across different educational levels, it offers a cohesive understanding of how AI can support lifelong learning. The book's structured approach, which includes sections on foundational knowledge, transformative teaching practices, ethical considerations, preparedness, and future trends, ensures that readers gain a holistic view of AI's role in education.

### *Preparing for the Future*

As AI continues to evolve, this book not only prepares educators for the immediate challenges but also anticipates future trends, offering guidance on how to stay ahead of the curve. By fostering a proactive

and informed approach to AI integration, the book contributes to the development of an education system that is resilient, innovative, and capable of preparing students for the demands of the 21st century.

As a newcomer to AI tools like ChatGPT, I too am both enthusiastic and inquisitive about the capacity of AI to effectively address the critical aspects within the eight dimensions of my *SMART Learning* framework, which emphasize sustainability, motivation, adaptability, results-oriented, and technology-enabled properties. While AI has shown great promise in automating tasks within well-defined domains of knowledge, I question its ability to navigate more complex, ill-defined domains where human intuition and insight are essential.

Before we entrust AI with greater responsibility, it is crucial to educate ourselves to recognize the situations and contexts in which AI may not be the most suitable solution. As educators, we must understand that while AI can be an immensely valuable tool in enhancing learning experiences, it has its limitations. Ultimately, our role is to guide learners in leveraging AI effectively while ensuring they are well-equipped to discern when human judgment is indispensable. Embracing AI as a powerful educational resource should go hand in hand with acknowledging its constraints and maintaining a balanced, informed perspective on its role within our evolving learning landscapes.

In summary, *Teaching and Learning in the Age of Generative AI: Evidence-Based Approaches to Pedagogy, Ethics, and Beyond* is a timely and indispensable resource for understanding and navigating the transformative potential of AI in both K-12 and higher education. It provides a roadmap for educators and institutions to leverage AI's capabilities responsibly and effectively, ensuring that the integration of this powerful technology leads to enhanced educational experiences and outcomes for all learners.

# Preface

The introduction of ChatGPT and other generative AI tools has triggered a wide range of reactions within the education community, from enthusiasm and curiosity to concern and apprehension. While many educators recognize the potential of these technologies to transform teaching and learning, others, like Danny Oppenheimer (2023) from Carnegie Mellon University, have raised alarms about the potential risks, particularly regarding academic integrity. The rapid integration of AI by tech giants such as Microsoft, Google, and Apple further complicates the landscape, compelling educators, administrators, and policymakers to address pressing challenges. They must find a balance between leveraging the innovative capabilities of generative AI and safeguarding the core values of education, such as fairness, integrity, and rigorous standards. This balancing act involves rethinking traditional approaches to teaching and learning, developing new policies to govern AI use in academic settings, and ensuring that students use these tools responsibly. By addressing these challenges thoughtfully, the education community can harness the power of AI to enhance the learning experience while upholding ethical principles and preserving the integrity of educational outcomes.

## Objectives of the Book

The purpose of this book is to equip educators and policymakers with the knowledge and strategies necessary for successfully integrating AI into education while maintaining ethical standards and preparing for future advancements. To accomplish this, the book will focus on the following objectives:

1. **Explore the Impact of Generative AI on Education:** The book aims to provide a comprehensive understanding of how generative AI technologies, such as ChatGPT, are transforming teaching, learning, and educational practices, while addressing both the opportunities and challenges they present.
2. **Develop Ethical and Responsible AI Policies:** Another objective is to guide educators, administrators, and policymakers in creating and implementing policies that balance the innovative potential of AI with the need to maintain academic integrity, fairness, and ethical standards.
3. **Enhance AI Literacy Among Educators and Students:** The book seeks to prepare educators and students to effectively engage with AI technologies by offering strategies for AI literacy, professional development, and the integration of AI into educational curricula.
4. **Address Institutional and Ethical Challenges:** It aims to tackle the ethical and institutional challenges that arise from AI integration in education, including issues related to bias, privacy, and the legal complexities of AI use, providing strategies to mitigate these risks.
5. **Anticipate Future Trends in AI-Driven Education:** The book looks ahead to the future of education, exploring emerging trends and the potential long-term impact of AI on educational environments, with the goal of helping institutions align their practices with the evolving demands of the AI era.

## Organization of the Book

This book guides readers through the transformative impact of artificial intelligence (AI) in education, beginning with a foundational understanding of generative AI and its key concepts. It explores how AI can revolutionize teaching, enhance student engagement, and

personalize learning. As AI integration raises ethical and institutional challenges, the book addresses necessary policies and frameworks for responsible use. It also emphasizes the importance of preparing educators and students to effectively engage with AI, providing strategies for fostering AI literacy. Concluding with a forward-looking perspective, the book delves into emerging trends and offers valuable insights on AI's transformative role in the future of education. The book is organized into the following five sections:

1. **Foundations and Frameworks of AI in Education.** This section lays the groundwork for understanding the role of generative AI in education, starting with an exploration of its rapid emergence and profound impact on teaching and learning. It introduces the foundational concepts of generative AI, such as ChatGPT, and addresses the ethical and pedagogical challenges these technologies pose. The section also presents a comprehensive framework for implementing AI in educational settings, focusing on institutional transformations, ethical practices, and personalized learning. Together, these chapters provide a solid foundation for understanding AI's current and potential roles in education.
2. **Transformative Teaching and Learning with AI.** This section delves into the transformative potential of AI in education, examining how AI can enhance personalized learning, engage students in new ways, and revolutionize traditional teaching methods. It explores the use of no-code chatbots like ChatGPT in the classroom, providing insights into their adoption and future implications. Additionally, the section highlights the role of AI in promoting critical thinking and problem-solving skills, while addressing the ethical dilemmas associated with AI integration in pedagogy. The focus here is on AI's capacity to reshape the educational landscape through innovative and engaging learning experiences.
3. **Ethical and Institutional Considerations.** This section tackles the ethical and institutional implications of AI integration in education, emphasizing the importance of preserving academic integrity, formulating responsible policies, and managing potential risks. It advocates for the adoption of diverse assessment techniques to mitigate AI-enabled cheating and foster critical thinking skills. The section also offers guidance on developing institutional policies that uphold legal compliance, data privacy, and ethical standards.

It also explores the risks associated with AI, including bias, disinformation, and privacy concerns, offering strategies to address these challenges. Lastly, it delves into the intricacies of fair use policies within higher education, ensuring that AI is used ethically and in accordance with copyright laws.

4. **Preparing Educators and Students for AI Integration.** This section addresses the critical need for preparing both educators and students to effectively engage with AI technologies. It offers strategies for teaching generative AI in higher education, focusing on quality assurance, ethical use, and curriculum design. The section also discusses how to integrate AI into teacher education, emphasizing the importance of AI literacy and professional development for pre-service and in-service teachers. Additionally, it provides practical ideas for educators to help students navigate an AI-driven world, emphasizing the importance of adaptability, collaboration, and critical engagement with AI tools.
5. **Future Trends and Implications of AI in Education.** Looking ahead, this section explores the future of AI in education, with a focus on emerging trends and their potential impact. It begins with a discussion on how AI challenges traditional assessment methods and offers strategies for developing reliable and authentic assessments in the age of AI. The section also examines the implications of AI on educational equity, addressing the digital divide and the need for inclusive AI deployment. It concludes by envisioning the future of education in 2040, where AI-driven technologies create dynamic, personalized learning environments, and by providing a framework for aligning educational content with the competencies needed in the AI era.

## Target Audience

This book is designed to appeal to a broad audience within the education sector, offering valuable insights and practical guidance for a variety of roles. Pre-service and in-service teachers will find the book particularly useful as it provides strategies and knowledge that are essential for both aspiring and practicing educators who want to effectively integrate AI into their teaching practices. Trainers and technology coordinators, who play a critical role in equipping educators

with the tools and knowledge they need, will benefit from the book's exploration of the opportunities and challenges associated with AI in education.

School and district-level administrators are another key audience, as the book offers a comprehensive understanding of the implications, benefits, and challenges that come with implementing AI in educational settings. For policymakers, the book can serve as an indispensable resource, offering guidance on how to shape AI policies and make informed decisions that will impact the future of education.

College and university faculty and administrators will also find this book valuable as it delves into the impact of AI on higher education, providing insights that can inform curriculum development, teaching practices, and institutional policies. Moreover, the book is an excellent resource for individuals engaged in self-directed study, whether they are educators, researchers, or simply those with a keen interest in the intersection of AI and education. It offers a thorough exploration of AI's role in shaping the future of learning, making it a must-read for anyone interested in the transformative potential of AI in education.



**Taylor & Francis**  
Taylor & Francis Group  
<http://taylorandfrancis.com>

# Part I

## Foundations and Frameworks of AI in Education



**Taylor & Francis**  
Taylor & Francis Group  
<http://taylorandfrancis.com>

# What Is Generative AI? A Primer

1

*Maria Elena Corbeil*

## Introduction

How many of us have marveled at sci-fi shows where, on command, a computer served Earl Grey tea or plotted the next course? While generative AI will not be serving tea anytime soon, it is transforming fields like education by automating tasks, generating creative content, and offering new ways to engage with information. Yet, with these advancements come growing concerns. It all started late in the fall 2022 semester, when on November 30, OpenAI released ChatGPT. What initially seemed like just another tech innovation soon became a major disruptor in education.

Just days prior to the start of Spring 2023, an alarming email landed in our inbox:

Subject Line: Emergency Meeting to Discuss ChatGPT Concerns

We need to convene an emergency meeting to discuss significant concerns related to ChatGPT, a new AI-powered application that has been gaining traction on social media and Higher Ed periodicals. The launch of ChatGPT this past November has sparked deep concerns among faculty, resulting in our office being inundated with anxious calls seeking guidance on the matter. An ad hoc committee has been formed to formulate a response to address the potential threat to academic integrity and establish a clear plan of action for the university moving forward. Your participation would be greatly appreciated.

## 4 Teaching and Learning in the Age of Generative AI

Since its release, ChatGPT and other generative AI apps have elicited a range of reactions among teachers and faculty ranging from curiosity and intrigue to nervousness and fear. As Danny Oppenheimer (2023) at Carnegie Mellon University observed, a sense of panic swept through the education community, including educators, administrators, and policymakers. Today, many educators find themselves confronted with the challenge of ensuring academic integrity in the aftermath of ChatGPT's emergence. Should we impose a ban? Can we effectively prevent students from utilizing it for cheating? How will this technology transform our teaching methods? Furthermore, as prominent software companies such as Microsoft, Google, and Apple gear up to incorporate generative AI into their products, how will we manage how students use the apps? What policies will we need to implement to mitigate the AI threat? These are the pressing questions educational stakeholders are currently grappling with in the wake of ChatGPT.

To address these questions, it is important to better understand what generative AI (GenAI) is. This chapter begins with an introduction to GenAI, defining and distinguishing it from artificial intelligence. It also charts its development from early AI innovations to the advanced models we know today, such as ChatGPT. The chapter also explores ethical challenges like AI-assisted cheating, detection difficulties, over-reliance on AI, and the need for updated policies. Finally, pedagogical opportunities afforded by GenAI are presented.

The chapter will afford readers with a deeper understanding of the disruptive yet transformative role generative AI plays in modern education, as well as the balance required to navigate its opportunities and challenges responsibly. By providing this foundational overview of GenAI's evolution, challenges, and potential in education, this introductory chapter sets the stage for the deeper exploration and nuanced discussions that follow in the subsequent chapters of this book.

### What Is Generative AI?

As its name indicates, generative AI evolved from the field of artificial intelligence (AI). Artificial intelligence refers to the development of systems designed to replicate specific aspects of human cognition, such as learning, decision-making, and problem-solving (Collins et al.,

2021). These tasks are carried out using mathematical models and algorithms that process large datasets rather than through conscious thought or human-like reasoning (Jarrahi, 2018). Zewe (2023) explains, “before the generative AI boom of the past few years, when people talked about AI, typically they were talking about machine-learning models that can learn to make a prediction based on data” (para. 3). Today, AI applications abound in healthcare, education, business, and even our homes. For example, AI powered platforms assist doctors in detecting diseases from scans, grade assignments in education, help business owners make marketing decisions based on consumer buying patterns, and manage home devices, such as lights and thermostats. Generative AI takes this a step further by not only processing information, but generating original content based on patterns it has learned from large amounts of data (Zewe, 2023).

According to Banh and Strobel (2023), advancements in AI in recent years “have enabled new paradigms of machine processing, shifting from data-driven, discriminative AI tasks toward sophisticated, creative tasks through generative AI” (p. 62). Generative AI platforms like OpenAI’s ChatGPT, Microsoft’s Co-Pilot, and Runway ML, available on both desktop and mobile devices, can create content such as images, videos, music, and text, based on user-provided instructions, known as prompts. A prompt serves as the user’s input, guiding the AI in generating the desired outcome. Unlike traditional AI that provides one-way outputs, generative AI tools enable more interactive experiences. For example, in healthcare, they personalize treatment plans; in education, they adapt lessons to student responses; in business, they handle customer queries through chatbots, and, at home, assistants like Alexa generate shopping lists, play music, suggest recipes, and more. Bengio et al. (2021) highlight that GenAI, while rooted in the foundational principles of AI, has evolved into a specialized subset with its own distinct methods and applications.

## How Did We Get Here? A Brief History

Generative AI gained widespread attention with the launch of ChatGPT in November 2022, making it new to many people worldwide, but its foundations trace back to research and computational advancements starting around the 1940s and 50s. Zewe (2023) notes, “despite the hype

## 6 Teaching and Learning in the Age of Generative AI

that came with the release of ChatGPT and its counterparts, the technology itself isn't brand new" (para. 6). Throughout history, no other concept has captured our imagination quite like the idea of intelligent machines. From the captivating dystopian world in the movie *2001: A Space Odyssey* to the sentient android in the TV series *Star Trek: The Next Generation*, these fictional examples have inspired both fascination and trepidation. This section traces the evolution of AI from its conceptual beginnings in the 1950s to recent breakthroughs in language processing, leading to advanced systems like ChatGPT. By examining key milestones such as the Turing Test, machine learning, neural networks, and natural language processing, we can better appreciate the technological advancements that have shaped modern conversational AI and brought us to this exciting era.

### 1950s

In 1950, several early conceptual foundations for AI emerged, including Claude Shannon's article on chess-playing computers and Alan Turing's pioneering work. Turing's (1950) influential paper, "Computing Machinery and Intelligence," proposed that machines could simulate human thought through computation, leading to the introduction of the Turing Test, designed to determine whether a machine's behavior could convincingly mimic human intelligence. A year later, advancements in AI moved from theoretical concepts to practical applications when Marvin Minsky and Dean Edmunds built the first artificial neural network, and in 1952, Arthur Samuel pioneered machine learning with his checkers-playing program (Press, 2016).

### 1960s

Expert Systems, which combined rule-based logic with a knowledge base of facts to simulate human decision-making in specialized fields, emerged in the 1960s. Another key milestone was ELIZA, a natural language processing program developed by Joseph Weizenbaum. ELIZA simulated therapy sessions using simple rules to engage users in conversation. Its legacy includes the ELIZA Effect, where people

anthropomorphize AI, influencing AI ethics by highlighting the risks of overestimating AI's capabilities (Sponheim, 2023).

## 1980s

Machine learning surged in the 1980s with the advancement of robots and AI with the development of algorithms that enabled computers to learn from data without the need for explicit programming instructions (Karjian, 2024). For example, in 1988, IBM's T.J. Watson Research Center introduced a statistical approach to language translation, shifting from rule-based to probabilistic methods and paving the way for generative AI by enabling learning from large datasets (Press, 2016). Press (2016) highlights other innovations like Japan's Wabot-2, a robot capable of reading and playing music and communicating with humans, as well as their investment in the Fifth Generation Computer project designed to create machines that could reason and hold conversations. He also points to key advances like the first driverless car launched in Munich in 1986, and the backpropagation algorithms developed by Rumelhart, Hinton, and Williams, which significantly advanced AI's ability to improve through experience (Bergmann & Stryker, 2024), moving us closer to the science fiction vision of AI interacting seamlessly with people.

## 1990s

Neural networks, modeled after the human brain, designed to learn and adapt to complex patterns, became a pivotal development in AI during the 1990s (Fan et al., 2020). However, according to Press (2016), their origins trace back to 1943 when McCulloch and Pitts published a paper on computational units capable of performing simple logical tasks. This foundational work later inspired the development of systems like neural networks and deep learning models (Press, 2016). Building on these foundational ideas, early AI applications like Dr. Sbaits in 1992, which simulated conversations as a psychologist, was "one of the earliest efforts of incorporating AI into a chatbot" (Law, 2022, para. 1). Three years later, A.L.I.C.E., a natural language processing chatbot

## 8 Teaching and Learning in the Age of Generative AI

inspired by ELIZA, engaged users in human-like dialogue, answering questions and mimicking real-life interactions (Law, 2022).

While these advancements were groundbreaking, what was to come would be even more transformative.

### 2000s

Building on previous achievements, the 2000s marked a pivotal decade for AI, with innovations that paved the way for generative AI, ushering in an era of unprecedented technological progress. The era began in 2000, when researchers from the University of Montreal proposed using neural networks to model language, marking a shift towards *deep learning*, a term coined by Geoffrey Hinton in 2006 (Karjiani, 2024). According to Li and Huang (2023), the emergence of deep learning techniques enabled AI to learn hierarchical representations from large amounts of data. Karjiani (2024) highlights the release of tools like Torch in 2002, describing it as “the first open-source machine learning library, offering interfaces to deep learning algorithms...” (Walk Along the Machine Learning Timeline, para. 30). He added that competitions such as the Netflix Prize and Kaggle (in 2006 and 2010 respectively) also played a crucial role in driving innovation in the field. Also, milestones such as the development of a convolutional neural network (CNN) named AlexNet, in 2012 revolutionized a computer’s ability to see (computer vision) by enabling AI to accurately recognize objects in images (Briggs & Carnevali, n.d.).

In 2014, generative adversarial networks (GANs) further advanced the field by allowing AI to generate realistic images, sounds, and other data (Fathima, 2024). The introduction of the transformer architecture in 2017 significantly improved natural language processing (NLP) tasks like translation, summarization, and question answering (Ghosh, 2024). These advancements transformed both computer vision, a field where AI interprets visual information like images and videos, and natural language processing, ultimately paving the way for powerful generative models such as ChatGPT and DALL-E.

In 2020, the field of natural language processing was revolutionized when OpenAI introduced GPT-3, a language model designed to generate human-like text based on user input prompts (Dale, 2021). It

showcased the power of large-scale generative models in conversational AI. Then, on November 30, 2022, OpenAI released ChatGPT, advancing dialogue systems and enabling more natural human–AI interactions. Around the same time, OpenAI was also making strides in image generation. In January 2021, it introduced DALL-E 1, which could generate unique and highly detailed images from textual descriptions. DALL-E 2, released in April 2022, further improved image fidelity and creative possibilities. Similarly, Google made advancements with its language model, LaMDA. When it launched its AI Test Kitchen app in 2022, users could interact with LaMDA (Law, 2022). Today, we have ChatGPT-4 which offers enhanced reasoning, improved handling of complex queries, greater creativity in its responses, and the ability to process larger inputs while producing more contextually accurate and detailed output (OpenAI, n.d.).

The development of AI and machine learning has been shaped by significant milestones, from Turing’s early theoretical foundations to the emergence of deep learning, transformer models, and cutting-edge generative tools. These advancements, including models like ChatGPT, and LaMDA, have profoundly expanded AI’s capabilities, transforming applications in language processing and conversational AI. Today, generative AI continues to impact everyday life, with tools like Grammarly enhancing writing for educators, IBM Watson Health aiding medical diagnosis, and Google Assistant and Amazon Alexa revolutionizing home automation. These technologies demonstrate the increasing influence of AI across education, healthcare, and personal spaces.

## Here We Are: Concerns and Possibilities

### *The Concerns*

While generative AI tools have become integral to many aspects of daily life, significant concerns persist in education, where educators are navigating how to prepare students for responsible AI use, addressing ethical dilemmas, and managing challenges related to academic integrity.

When ChatGPT made its debut in November 2022, it was unlike any other AI-driven app before it. As Alex Klein (2023), MIT graduate

## 10 Teaching and Learning in the Age of Generative AI

and product designer at Team Human, observed, “there’s something different about this moment compared to other recent tech ‘fake-outs’ like voice assistants, the metaverse, and Web3. They all promised to be game-changers, and I admit, I believed them” (para. 4). In the buildup to the start of the 2023 Spring semester, as news of the latest generative AI technology spread, K-12 teachers and university professors worldwide began to voice genuine concerns regarding its potential impact on education. In an opinion piece published in *Inside Higher Ed*, Jeremy Weissman (2023) characterized ChatGPT as a formidable threat, likening it to “a new sort of plague” that, unlike the COVID-19 pandemic, “endangers our minds more than our bodies” (para. 2). Weissman cautioned that, similar to the early days of the pandemic, many educators have yet to fully comprehend the stark reality of the impending educational disruption. Following the introduction of ChatGPT, several school districts across the United States swiftly imposed bans on student access, including in New York, Los Angeles, Virginia, and Seattle (Johnson, 2023) to name a few. Moreover, numerous universities around the world have cautioned students that employing ChatGPT for assignments may lead to charges of plagiarism and academic misconduct (Mearian, 2023).

The increasing use of AI in classrooms has raised significant concerns about its impact on academic integrity, particularly around cheating and the adequacy of existing educational policies. Tools like ChatGPT allow students to generate entire essays, assignments, and test responses, bypassing traditional research and writing processes and making it more difficult for educators to identify academic dishonesty (Cotton et al., 2024). Cotton et al. (2024) also point out that “the responses generated by the chatbot application may not accurately reflect the student’s true level of understanding” (What Are the Challenges of ChatGPT for Assessment in Higher Education? para 3), complicating educators’ efforts to accurately assess students’ learning.

Ethical concerns in education related to AI, including bias, data privacy, and over-reliance on technology, are also becoming increasingly prominent as AI tools are more widely integrated into learning environments. AI models can unintentionally perpetuate biases present in their training data, leading to unequal or discriminatory outcomes (Bender et al., 2021; Bigelow et al., n.d.). Corbeil and

Corbeil (2022) observe “the potential for bias is a major concern. It is complex because, on the one hand, AI mediates bias by removing or reducing human subjectivity in the decision-making process” (p. 50). On the other hand, online examples abound demonstrating how AI biases have already impacted, or could potentially affect, students both inside and outside the classroom (e.g., Greene-Santos, 2024; Mutiga, 2024; Young, 2020).

Other concerns closely intertwined with bias stem from data privacy, as GenAI systems typically require access to large amounts of information to function effectively. First, AI-driven tools may handle sensitive student information, such as personal and academic records, which are vulnerable to data breaches. Second, the widespread adoption of AI in education may involve biometric tracking and student monitoring, complicating consent and raising surveillance concerns (Hernandez-de-Mendez et al., 2021). Third, students may unknowingly input personal data or images into GenAI tools as part of the prompts, not realizing that this information is stored and used for system improvement, heightening privacy risks (Bender et al., 2021).

Additionally, over-reliance on AI tools in decision-making or by students for assignments could lead to diminished critical thinking skills and human oversight (Zhai et al., 2024). Zhai et al. (2024) observe: “overreliance on AI occurs when users accept AI-generated recommendations without question, leading to errors in task performance in the context of decision-making” (Abstract, para. 1). They argue that when users struggle to evaluate AI’s reliability, they are more likely to trust and rely too heavily on content generated by GenAI systems.

To exacerbate an already tense situation, AI detection tools have also begun to emerge, with mixed success in detecting AI-generated content. One of the biggest players in AI detection is Turnitin, the anti-plagiarism application used by thousands of K-12 schools and institutions around the world (Kuykendall, 2023). Critics of the software argue that unlike its plagiarism detection tool that highlights potentially plagiarized text and provides links to the original sources, its AI detection tool only provided a statistical probability that a passage was AI generated, and the accuracy of the predictions have yet to be vetted through peer review (Knox, 2023). A case in point, recently one AI detector determined that large portions of the US Constitution were likely written by an AI (Sabreena, 2023).

## 12 Teaching and Learning in the Age of Generative AI

As Steven Williams, Principal Product Manager at the UCLA Learning Management Systems Center of Excellence, observed in an email to *Inside Higher Ed*:

We are just beginning to have conversations with instructors about AI-generated writing in multiple contexts, but the sudden and unexpected availability of detection technology significantly shifts the tone and goals of these discussions... Introducing this feature is a major change, but Turnitin's timeline does not offer sufficient time to prepare technically or pedagogically. (Cited in Knox, 2023, para. 7).

Williams worried that, just as educators were beginning to have conversations about generative AI in education, the sudden emergence of AI detectors would “shift the tone and goals of these discussions,” possibly thwarting potential pedagogical innovations made possible by generative AI (Knox, 2023, para. 7).

These concerns highlight the need for careful consideration of AI’s role in education. As a result, education institutions are revisiting policies and assessment strategies to safeguard academic integrity in the age of AI (Luo, 2024).

### *The Possibilities*

While many academics expressed valid concerns regarding the potential threats accompanying the sudden integration of AI-driven tools such as ChatGPT in education, others were cautiously embracing their potential as valuable instructional aids for both teachers and students. In an op-ed in the *Los Angeles Times*, Angela Duckworth, a psychology professor at the University of Pennsylvania, advocated for the use of ChatGPT to challenge educators to change how they taught. She argued:

Banning ChatGPT is like prohibiting students from using Wikipedia or spell-checkers. Even if it were the “right” thing to do in principle, it is impossible in practice. Students will find ways around the ban, which of course will necessitate a further defensive response from teachers and administrators,

and so on. It's hard to believe that an escalating arms race between digitally fluent teenagers and their educators will end in a decisive victory for the latter. (Duckworth & Unger, 2023, para. 6)

Duckworth and Unger (2023) acknowledged that while intelligent chatbots were the perfect cheating tool, they could also help to prioritize critical thinking skills. They argued, as computers become capable of providing answers to questions, albeit sometimes inaccurately, there is an increasing necessity for students to strengthen their ability to discern which questions to pose and how to verify the information generated by the application. According to Abramson (2023), AI should not be viewed as a force that diminishes student effort. Instead, it can be harnessed to equip students with the necessary skills for navigating the real world, particularly by fostering critical thinking abilities. She argued, "with the right approach, ChatGPT can... prepare students for their future careers" (para. 7).

AI also has the potential to support teachers by automating content creation and facilitating assessment processes, allowing educators to focus more on interacting with students and personalizing instruction (World Economic Forum, 2024). AI-driven tools, such as adaptive learning platforms, can also tailor educational content to meet individual student needs, enhancing engagement by providing customized learning experiences. Furthermore, many of these tools offer real-time feedback, helping students progress at their own pace while enabling teachers to monitor performance more efficiently and adjust their teaching strategies accordingly (Cardona et al., 2023). This personalized approach opens new possibilities for a more inclusive and responsive learning environment. Melissa Gordon, a high school business teacher who is using AI with her students, "saw this as an opportunity to teach students to use AI as a tool not as a substitute for learning" (Greene-Santos, 2024, para. 4).

On the administrative side, GenAI can also help administrators and educational leaders in several ways. For example, GenAI systems can help streamline routine tasks, such as drafting emails and generating reports, allowing administrators to focus on strategic planning. It can also analyze large datasets, providing insights into student performance or enrollment trends, supporting more informed decision-making

## 14 Teaching and Learning in the Age of Generative AI

(American Federation of School Administrators, 2023). It can also assist administrators optimize how they allocate resources by analyzing financial data and predicting enrollment trends. This enables more accurate decision-making in staffing, classroom space, and funding to ensure efficient use of resources.

### Summary

The rapid development of AI technologies presents both challenges, such as those to academic integrity, and exciting new opportunities for enriching teaching and learning. Much like the self-learning systems imagined in films like *The Matrix*, today's AI models are evolving beyond simple computation, stepping into roles that once seemed reserved for science fiction. Klein (2023) observes, "AI is the next chapter for us... because it has proven to be immediately useful, seamlessly integrating into our daily lives" (para. 4). He adds, "large language models (and ChatGPT in particular) have become the next big thing because they have awed us with their power" (para. 4).

However, like all powerful tools, AI presents ethical dilemmas, reminding us of Asimov's (1950) Three Laws of Robotics, which elucidated the need for technology to be carefully guided to prevent harm. The transformative potential of generative AI in education is undeniable, but it is important that it be balanced with responsible and ethical use. As we look ahead, we are reminded of Marvin Minsky's bold 1970 prediction that machines would achieve human-level intelligence within a few years. While his timeline was overly optimistic, his vision has significantly influenced advancements in artificial intelligence today. Now, much like the uncertain future of AI depicted in *Blade Runner*, the rise of generative AI leaves us with the question: What comes next?

To help answer that question, this book will guide educators on effectively leveraging generative AI in education, while addressing its implications for teaching and learning. Through an analysis of AI's past and future, it will explore the institutional, pedagogical, technical, ethical, and societal dimensions of AI adoption. Practical strategies for classroom integration, alongside discussions of its benefits and risks, will be highlighted. Additionally, the book will provide educators with

tools to prepare students for an AI-driven future, equipping them for success in a rapidly evolving technological landscape.

## Discussion Questions

1. What is generative AI, and how does it differ from traditional AI? Please provide examples of how it might be used for learning in education and/or the workplace?
2. What are the key advancements that have led to the development of GenAI tools like ChatGPT? How do these advancements help explain the sudden popularity of these tools?
3. How might GenAI enhance learning experiences for learners and educators? Provide examples.
4. What are some common concerns people have about the use of GenAI in education? How can these concerns be addressed to ensure its ethical use?
5. As GenAI becomes more widespread, what basic knowledge or skills should learners and educators have to use these tools effectively and responsibly in educational settings?

## References

Abramson, A. (2023, May 7). *How to use ChatGPT as a learning tool*. American Psychological Association. [www.apa.org/monitor/2023/06/chatgpt-learning-tool](http://www.apa.org/monitor/2023/06/chatgpt-learning-tool)

American Federation of School Administrators. (2023). *Artificial intelligence and education*. [www.theschoolleader.org/news/artificial-intelligence-and-education](http://www.theschoolleader.org/news/artificial-intelligence-and-education)

Asimov, I. (1950). Runaround. In *I, Robot* (The Isaac Asimov Collection). Doubleday.

Banh, L., & Strobel, G. (2023). Generative artificial intelligence. *Electronic Markets*, 33(63). <https://doi.org/10.1007/s12525-023-00680-1>

Bender, E. M., et al. (2021). *On the dangers of stochastic parrots: Can language models be too big?* <https://dl.acm.org/doi/10.1145/3442188.3445922>

Bengio, Y., LeCun, Y., & Hinton, G. (2021). Deep learning for AI and its impact on technology and society. *Nature Reviews Physics*, 3(3), 129–143. <https://doi.org/10.1038/s42254-021-00296-8>

## 16 Teaching and Learning in the Age of Generative AI

Bergmann, D., & Stryker, C. (2024, July 2). *What is backpropagation?* IBM. [www.ibm.com/think/topics/backpropagation](http://www.ibm.com/think/topics/backpropagation)

Bigelow, S. J., Gillis, A. S., & Pratt, M. K. (n.d.). What is machine learning bias (AI bias)? *Tech Accelerator*. [www.techtarget.com/searchenterpriseai/definition/machine-learning-bias-algorithm-bias-or-AI-bias#:~:text=Share%20this%20item%20with%20your,the%20quality%20of%20the%20input](http://www.techtarget.com/searchenterpriseai/definition/machine-learning-bias-algorithm-bias-or-AI-bias#:~:text=Share%20this%20item%20with%20your,the%20quality%20of%20the%20input)

Briggs, J., & Carnevali, L. (n.d.). ImageNet. In *Embedding methods for image search*. Pinecone. [www.pinecone.io/learn/series/image-search/imagenet](http://www.pinecone.io/learn/series/image-search/imagenet)

Cardona, M. A., Rodríguez, R. J., & Ishmael, K. (2023, May). *Artificial intelligence and the future of teaching and learning*. US Department of Education, Office of Educational Technology. [www2.ed.gov/documents/ai-report/ai-report.pdf](http://www2.ed.gov/documents/ai-report/ai-report.pdf)

Collins, C., Dennehy, D., Conboy, K., & Mikalef, P. (2021). Artificial intelligence in information systems research: A systematic literature review and research agenda. *International Journal of Information Management*, 60, 102372.

Corbeil, M. E., & Corbeil, J. R. (2022). Establishing trust in artificial intelligence in education. In M. A. Marzilli (Ed.), *Artificial intelligence in higher education: Learning, pedagogy, and trust* (pp. 61–78). Routledge.

Cotton, D. R. E., Cotton, P. A., & Shipway, J. R. (2024). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International*, 61(2), 228–239. <https://doi.org/10.1080/14703297.2023.2190148>

Dale, R. (2021). GPT-3: What's it good for? *Natural Language Engineering*, 27(1), 113–118. <https://doi.org/10.1017/S1351324920000601>

Duckworth, A., & Unger, L. (2023, January 19). Op-ed: Don't ban chatbots in classrooms—use them to change how we teach. *Los Angeles Times*. [www.latimes.com/opinion/story/2023-01-19/chatgpt-ai-education-testing-teaching-changes](http://www.latimes.com/opinion/story/2023-01-19/chatgpt-ai-education-testing-teaching-changes)

Fan, J., Fang, L., Wu, J., Guo, Y., & Dai, Q. (2020). From brain science to artificial intelligence. *Engineering*, 6(3), 248–252.

Fathima, S. (2024, February 23). *Revolutionize AI and ML: The impact of generative adversarial networks*. MarkovML. [www.markovml.com/blog/generative-adversarial-networks](http://www.markovml.com/blog/generative-adversarial-networks)

Ghosh, S. (2024, August 19). The transformer model: Revolutionizing natural language processing. *Medium*. <https://medium.com/@siladityaghosh/the-transformer-model-revolutionizing-natural-language-processing-3e863a69ecfb>

Greene-Santos, A. (2024, February 22). Does AI have a bias problem? *NEA Today*. [www.nea.org/nea-today/all-news-articles/does-ai-have-bias-problem](http://www.nea.org/nea-today/all-news-articles/does-ai-have-bias-problem)

Hernandez-de-Menendez, M., Morales-Menendez, R., Escobar, C. A., & Arinez, J. (2021). Biometric applications in education. *International Journal on Interactive Design and Manufacturing (IJIDeM)*, 15(3), 365–380.

Jarrahi, M. (2018). Artificial intelligence and the future of work: Human–AI symbiosis in organizational decision making. *Business Horizons*. <https://doi.org/10.1016/J.BUSHOR.2018.03.007>

Johnson, A. (2023, January 18). ChatGPT in schools: Here's where it's banned—and how it could potentially help students. *Forbes*. [www.forbes.com/sites/ariannajohnson/2023/01/18/chatgpt-in-schools-heres-where-its-banned-and-how-it-could-potentially-help-students](https://www.forbes.com/sites/ariannajohnson/2023/01/18/chatgpt-in-schools-heres-where-its-banned-and-how-it-could-potentially-help-students)

Karjian, R. (2024). History and evolution of machine learning: A timeline. *TechTarget*. [www.techtarget.com/whatis/A-Timeline-of-Machine-Learning-History](https://www.techtarget.com/whatis/A-Timeline-of-Machine-Learning-History)

Klein, A. (2023, May 10). 5 use cases for human-centered AI. *Medium*. <https://uxdesign.cc/5-use-cases-for-human-centered-ai-3e48372512c2>

Knox, L. (2023, April 3). Can Turnitin cure higher ed's AI fever? *Inside Higher Ed*. [www.insidehighered.com/news/2023/04/03/turnitins-solution-ai-cheating-raises-faculty-concerns](https://www.insidehighered.com/news/2023/04/03/turnitins-solution-ai-cheating-raises-faculty-concerns)

Kuykendall, K. (2023, March 27). The sky is not falling: Turnitin urges educators to “meet the moment” of ChatGPT. *THE Journal Insider*. <https://thejournal.com/articles/2023/03/27/podcast-the-sky-is-not-falling-turnitin-meet-the-moment-of-chatgpt.aspx>

Law, M. (2022, December 7). From ELIZA to ChatGPT: The evolution of chatbots technology. *Technology Magazine*. <https://technologymagazine.com/articles/from-eliza-to-chatgpt-the-evolution-of-chatbots-technology>

Li, C., & Huang, H. (2023). Emergence of hierarchical modes from deep learning. *Physical Review Research*, 5. <https://doi.org/10.1103/PhysRevResearch.5.L022011>

Luo, J. (2024). A critical review of GenAI policies in higher education assessment: A call to reconsider the “originality” of students’ work. *Assessment & Evaluation in Higher Education*, 49(5), 651–664.

Mearian, L. (2023, April 25). Schools look to ban ChatGPT, students use it anyway. *Computerworld*. [www.computerworld.com/article/3694195/schools-look-to-ban-chatgpt-students-use-it-anyway.html#:~:text=The%20second%20largest%20school%20district,California%2C%20and%20Seat%20Public%20Schools](https://www.computerworld.com/article/3694195/schools-look-to-ban-chatgpt-students-use-it-anyway.html#:~:text=The%20second%20largest%20school%20district,California%2C%20and%20Seat%20Public%20Schools)

Mutiga, A. N. (2024, July 1–5). *AI in education: Mapping NIST AI biases to understand and mitigate them in teaching and learning applications*. EdMedia 2024, Brussels, Belgium.

## 18 Teaching and Learning in the Age of Generative AI

OpenAI. (n.d.). GPT-4. <https://openai.com/index/gpt-4>

Oppenheimer, D. (2023, January 17). ChatGPT has arrived—and nothing has changed. *Times Higher Education—Campus*. [www.timeshighereducation.com/campus/chatgpt-has-arrived-and-nothing-has-changed](http://www.timeshighereducation.com/campus/chatgpt-has-arrived-and-nothing-has-changed)

Press, G. (2016). A very short history of artificial intelligence (AI). *Forbes*. [www.forbes.com/sites/gilpress/2016/12/30/a-very-short-history-of-artificial-intelligence-ai](http://www.forbes.com/sites/gilpress/2016/12/30/a-very-short-history-of-artificial-intelligence-ai)

Sabreena, K. (2023, April 22). AI-detector flags US Constitution as AI-generated. *Analytics Vidhya*. [www.analyticsvidhya.com/blog/2023/04/ai-detection-can-ai-generated-content-really-be-detected/](http://www.analyticsvidhya.com/blog/2023/04/ai-detection-can-ai-generated-content-really-be-detected/)

Sponheim, C. (2023, October 6). *The ELIZA effect: Why we love AI*. Nielsen Norman Group. [www.nngroup.com/articles/eliza-effect-ai](http://www.nngroup.com/articles/eliza-effect-ai)

Turing, A. M. (1950). Computing machinery and intelligence. *Mind*, 49, 433–460.

Weissman, J. (2023, February 8). ChatGPT is a plague upon education (opinion). *Inside Higher Ed*. [www.insidehighered.com/views/2023/02/09/chatgpt-plague-upon-education-opinion](http://www.insidehighered.com/views/2023/02/09/chatgpt-plague-upon-education-opinion)

World Economic Forum. (2024, April). *The future of learning: How AI is revolutionizing education 4.0*. World Economic Forum. [www.weforum.org/agenda/2024/04/future-learning-ai-revolutionizing-education-4-0](http://www.weforum.org/agenda/2024/04/future-learning-ai-revolutionizing-education-4-0)

Young, J. R. (2020, June 26). Researchers raise concerns about algorithmic bias in online course tools. *EdSurge*. [www.edsurge.com/news/2020-06-26-researchers-raise-concerns-about-algorithmic-bias-in-online-course-tools](http://www.edsurge.com/news/2020-06-26-researchers-raise-concerns-about-algorithmic-bias-in-online-course-tools)

Zewe, A. (2023). Explained: Generative AI—How do powerful generative AI systems like ChatGPT work, and what makes them different from other types of artificial intelligence? *MIT News*. <https://news.mit.edu/2023/explained-generative-ai-1109>

Zhai, C., Wibowo, S., & Li, L. D. (2024). The effects of over-reliance on AI dialogue systems on students' cognitive abilities: A systematic review. *Smart Learning Environments*, 11(28). <https://doi.org/10.1186/s40561-024-00316-7>

# Developing a Framework for Implementing AI in Education and Evaluating Its Use

# 2

*Leticia De Leon*

## Introduction

Artificial intelligence has been embraced in many aspects of education despite the potential misuse of it and questions about ethical conduct. However, as an innovative technology, it has already fulfilled many promising practices for educators, including generating lesson plans, differentiated instruction, and creating activities in any given topic, including ways to adjust them for different grade levels. These are skills that teachers develop over years of educator preparation programs and experience. Developing this type of expertise takes a great deal of time and training, but the training is only part of the time educators spend practicing their craft. Educators are already overworked and overburdened by the increasing tasks and responsibilities with which they are tasked. The promise of reducing three hours of work to five minutes is too tempting to ignore.

Yet, when an innovative technology disrupts our current method of thinking or operating, we also have to consider what criteria we apply for using it, as well as whether it is as effective as it promises. Who measures this? What criteria should be used to evaluate its use and

## 20 Teaching and Learning in the Age of Generative AI

what are the long-reaching consequences to learning and pedagogy? Clearly, diving headfirst into disruption can have its benefits, but it can also have its drawbacks if we do not do it judiciously. Walczak and Cellary (2023) found in a survey that while students are using generative AI, not all of them trust it, and most of them are not able to determine which generated content is incorrect. This seems to suggest that the use of generative AI requires guidance, and it requires a new set of digital literacy skills focused on artificial intelligence. Yet, even this cautionary tale does not curtail the abundance of enthusiasm for AI in education.

Exploring ways in which artificial intelligence is being used in education can also provide a backdrop for evaluating its uses. Goksel and Bozkurt (2019) describe how education uses AI for adaptive learning, personalization, and intelligent tutoring systems. Lin et al. (2023) also discuss various AI systems that offer ways to personalize instruction and feedback to address learning gaps. Shrungare (2022) discusses how it can change assessment and evaluation, where AI is used for grading and assessments. Owan et al. (2023) also describe the uses of AI for assessment and focus on how it can improve their accuracy and efficiency, including personalizing feedback for students. They draw a parallel between feedback and better learning outcomes. These ideas are further reinforced by Okello (2023) who also extends these types of efficiencies and accuracies to instruction, including the work teachers do when teaching and delivering relevant content.

There is certainly a lot of promise in the use of AI in education for improving learning outcomes for students, as well as for empowering teachers to be more efficient in their instructional planning. What needs to be examined further is how their uses may have intended or unintended consequences regarding ethical use, the evolving nature of pedagogy, how institutions are affected, as well as how society explores these issues. Evaluating all these consequences would necessitate a framework through which to evaluate AI's overall effectiveness, and how they impact other systems which frame education. This chapter proposes a framework—the *Nested Framework for Implementing AI in Education*—for evaluating the effectiveness of AI in education by utilizing a framework synthesis methodology to develop it.

## Review of the Literature on AI for Education

This chapter will review the literature in two parts. First, it will provide an overview of the research that currently exists on the uses of AI for education. This will provide a backdrop for how AI has been used and studied, and the impact it has had. Several systematic reviews seem to suggest that AI in education can impact several systems in schools, which include learning, instruction, decision-making, administration, and adaptability. The second part of the review of literature will occur when describing the methodology of this paper.

This literature review finds that research on the use of generative AI for education is still very limited in scope. It establishes some important themes from other studies that explore AI in its earlier versions, which used deep learning and machine learning algorithms in educational applications. When we consider these uses with the ones that generative AI also promised to deliver, there are some very interesting parallels drawn. The literature then reveals several significant categories for education: assessment and teaching, ethics of AI, and personalization. A smaller subset of studies explore the actions of school administrators and leaders and societal implications.

### *Assessments and Teaching*

Ensuring that all students learn is a fundamental goal for teachers, but the diverse abilities and needs of students can make achieving this goal challenging. Various systematic reviews have explored the possibility of artificial intelligence to alleviate these difficulties. For example, González-Calatayud et al. (2021) reviewed assessments and found that AI has the potential to be effective for improving student performance, as well as yielding more accurate results than other means of assessment.

Dogan et al. (2023) focus their systematic review on online learning and distance education. In particular, they examined how algorithms were used for predicting student behavior. Although the studies they synthesized largely focused on science, engineering, and math, they found it was likely possible to enhance online learning through the use of AI. This includes the use of machine learning to analyze large data sets from students to help identify personalized learning paths.

Additionally, Ahmad et al. (2021) conducted a systematic review of the available uses of AI in education in such areas as tutoring, smart learning, and social robots. They found that AI can benefit education through multiple delivery systems, which can personalize learning for students. They also observed that AI can make administrative tasks much more efficient. This review did not include any uses of large language models or generative AI because they were not available in education at the time. Chen et al. (2020) also focused their systematic review on how AI in education can improve efficiency in teaching and learning through the personalization of curriculum. They found additional efficiencies in the completion of administrative tasks.

In a rare experimental study on the use of generative AI for instruction, Jauhiainen and Guerra (2023) conducted a study with primary students who received personalized instruction generated by ChatGPT 3.5. Their study found that there is a possibility for personalizing instructions and that students demonstrated greater engagement with AI-generated materials. The researchers caution that further refinement needs to be applied to its use, but they suggest that there is a promising opportunity for supporting sustainable development of the technology to support teachers in planning and resource efficiency, and to better address inclusivity and multilingual teaching. Zafari et al. (2022) also suggested in their systematic literature review the benefits AI could bring to personalized learning, as well as the likelihood of improving learning outcomes for students. Adiguzel et al. (2023) also reinforce the ideas that AI can benefit the personalization of education by tailoring to student needs. They add that chatbots can provide useful feedback for students that helps with learning outcomes. They also caution that AI can be biased and can inadvertently generate inequalities in how instruction is implemented, especially if teachers are not appropriately trained on its use.

### *Ethics of AI*

As soon as the topic of AI switches to generative AI in teaching, ethical concerns begin showing up in the literature. For instance, Kadaruddin (2023) explains that the existing literature outlines how educators can use generative AI to create instructional plans, while also addressing possible ethical problems dealing with data privacy and algorithmic

bias, two common concerns in the use of generative AI. However, this literature review also considers other ethical concerns. The first involves re-evaluating the teacher's role in planning with AI, and the second focuses on building trust through transparent use of the technology. Additional concerns also arise regarding equity of use, so that AI does not become another innovative technology that inadvertently causes inequities in access for students and teachers. For example, Oh et al. (2023) conducted a survey with undergraduates in their writing and the use of AI. In this context, students were aware of the ethical considerations, but they lacked knowledge and skill in proper citation, with students demonstrating various levels of awareness in the ethical use of generative AI in their papers.

Prather et al. (2023) provide important ethical considerations through an analysis of literature, a survey conducted with computing students and instructors, and interviews with computing educators. When they compared their findings to a formal code of ethics in computing, they found that pedagogy was already changing to encompass generative AI as a learning assistant. However, there were concerns about accuracy and the potential for student misuse through misrepresentation of work. Other papers focus on the need for more responsible development of large language models like generative AI to minimize bias, improve reliability, and create frameworks (Kenthapadi et al., 2023).

Akgun and Greenhow (2022) echo the same ethical concerns, but also add the problem of leaving out culturally relevant and responsive pedagogies when relying solely on AI for curriculum development. This could further lead to bias and discrimination. Tlili et al. (2023) further explore bias and potential discrimination highlighting through their case study that some content may be inaccurate. They also note that generating assessments based on this content may yield varying degrees of difficulty. Another drawback is AI's lack of generated emotions, which inhibits its ability to interpret information through the lens of human values.

### *Administration and Leaders in AI for Education*

Artificial intelligence in education requires that leaders and administrators in schools be aware of the possibilities and lead with intent. When AI makes it into education, the question we need to

ask ourselves is, does this also change the way leaders lead in schools? Carter and White (2021) discuss the role of the leader during disruptive times, and these disruptions include how technology changes the landscape of education. Crawford et al. (2023) talk about teachers as leaders in the use of generative AI and indicate the importance of role modeling, critical thinking promotion, guidance and direction, and support and feedback. Students also need a hands-on approach if they are to learn proper AI use. Crawford et al. (2023) also propose adding character education to this mix so students develop moral character, self-awareness, and ethics.

## The Framework Synthesis Method

In the previous section, the literature revealed the principal areas of research that artificial intelligence has focused on in recent years. Because generative AI is an emergent technology, many current studies employ literature review methods to synthesize findings related to theoretical aspects or those found within specific closed AI systems. Studies in education and generative AI are scarce, as it has not become widespread in its use until recently, within the last year or two.

As literature continues to explore the use of AI in education, several frameworks have emerged in response to the significant concerns regarding ethical practices, as well as the appropriate way to integrate artificial intelligence. As a result, this chapter will use a framework synthesis method to analyze these frameworks (Cardoso Ermel et al., 2021; Carroll et al., 2011). This methodology is typically used in healthcare practice to influence policy, but it has since gained prominence as a literature synthesis methodology (Brunton et al., 2020). Indeed, Carroll et al. (2011, p. 76) call it a “best fit” model because it starts with the use of already existing frameworks in the absence of clear theory. This is also why this method is considered a rapid synthesis. In this instance, the framework synthesis offers several relevant features for proposing a framework for evaluating the use of generative AI in education. The first is the possibility of influencing policy. Given the concerns already expressed in the literature about ethics and fair use, a framework that also provides guidance on policy for AI use is beneficial and needed. The second feature of this methodology is its use of existing frameworks to advance the synthesis method.

The use of existing frameworks is particularly important in an area of research that is scarce and relatively new. Brunton et al. (2020) further indicate that using framework synthesis also offers flexibility in coding and can be valuable in exploring or developing new theories. These features are important when delving into a topic of exploration that is largely new.

While framework synthesis may not be extensively documented in the literature, Carroll et al. (2011) and Cardoso Ermel et al. (2021) have delineated key procedural steps for developing a new framework.

1. Identify already existing frameworks or models
2. Search for studies that align with the concepts of these frameworks
3. Find new concepts and relationships
4. Build a new framework

This method will engage in a sequential approach as outlined above, which will integrate analysis and synthesis throughout the process. By the end of this section, a new proposed framework will have emerged from this iterative and sequential process.

## *Existing Frameworks*

The first step in a framework synthesis is to find already existing frameworks. When searching for existing frameworks, only those based on an analytic or synthesis process were considered. Frameworks described as theoretical or conceptual, with no substantive research behind them, were discarded. The frameworks included in this study are listed in Table 2.1 below with summaries of their purpose, methods, and concepts.

Table 2.1 includes a fifth column which categorizes each framework. This became necessary because their foci and structures were vastly different. It also became clear that creating a comprehensive framework for evaluating the effectiveness of AI in education was going to involve a multilayered approach that was intricately and inexorably intertwined with its effective design. This was akin to developing a rubric that could not only provide a means to evaluate how effectively AI is being used in education, but also establish criteria for its effective design. Generally, the frameworks fell into three categories or

TABLE 2.1 Existing Frameworks for AI Use

Framework	Purpose	Methods	Concepts	Category
Tapalova et al. (2022) Personalized Learning in AIEd (AI in Education)	Outlines AI-created pathways for personalized learning	Case study with survey	<ul style="list-style-type: none"> <li>• Social networking with chatbots</li> <li>• Expert education systems</li> <li>• Intelligent mentors</li> <li>• Machine learning</li> <li>• Personalized educational system</li> <li>• Virtual environments</li> </ul>	AI-Driven Personalized Learning
Klopov et al. (2023) Cognitive Model	Develop critical and reflective thinking through improved cognitive models and methods of learning	Varied (including big data mining, literature review, system testing)	<ul style="list-style-type: none"> <li>• Deep learning for creating engaging and more personalized learning</li> <li>• Deep understanding of educational digital concepts</li> <li>• Formation of values and culture to meet the challenges of modern development</li> </ul>	AI-Driven Personalized Learning
Holmes et al. (2021) Described as the ethics of AIEd framework, but not specifically named	Outlines the ethical areas of consideration for the use of AI in education	Survey of experts in AI in education	<ul style="list-style-type: none"> <li>• Ethics of algorithms in education</li> <li>• Ethics in learning analytics</li> <li>• Ethics of data used in AI</li> </ul>	Ethical Practice

Hong et al. (2022) Data Ethics Framework	Ensure that ethical practices are promoted when using AI in education	Literature review	<ul style="list-style-type: none"> <li>Transparency</li> <li>Privacy</li> <li>Accountability</li> <li>Inclusiveness</li> <li>Security</li> <li>E-learning centers</li> <li>Intelligent educational recommendation systems</li> <li>Quality management centers</li> <li>Research centers in AI (p. 232)</li> <li>Users include learners, teachers, and administrators</li> </ul>	Ethical Practice
Ghnem et al. (2022) Higher Education Transformation Framework	Change the structure of institutions for using AI for intensive knowledge, skills, and experiences	Systematic literature review	<ul style="list-style-type: none"> <li>E-learning centers</li> <li>Intelligent educational recommendation systems</li> <li>Quality management centers</li> <li>Research centers in AI (p. 232)</li> <li>Users include learners, teachers, and administrators</li> <li>Learning platforms</li> <li>Intelligent technology</li> <li>Curriculum that includes assessment and data-driven practices</li> </ul>	Institutional Transformation
Thongprasit and Wannapiroon (2022) Intelligent Learning Platform	"Develop a learning platform of modern smart education to prepare for the digital transformation" (p. 83)	Systematic literature review and expert review	<ul style="list-style-type: none"> <li>Learning platforms</li> <li>Intelligent technology</li> <li>Curriculum that includes assessment and data-driven practices</li> <li>User interactive components and technology of AI</li> <li>Components and technology of AI</li> <li>Roles for AI in education</li> <li>Machine learning and deep learning</li> <li>Decision support system modules</li> <li>Application of AI in education</li> <li>AI to enhance campus efficiencies</li> </ul>	Institutional Transformation
Jantakun et al. (2021) Framework for Artificial Intelligence in Higher Education (AAI-HE) Model	Transform higher education with a guide for researchers and educators for best practices in AI—it is a management plan for administrators	Expert development of model and expert evaluation	<ul style="list-style-type: none"> <li>User interactive components and technology of AI</li> <li>Components and technology of AI</li> <li>Roles for AI in education</li> <li>Machine learning and deep learning</li> <li>Decision support system modules</li> <li>Application of AI in education</li> <li>AI to enhance campus efficiencies</li> </ul>	Institutional Transformation

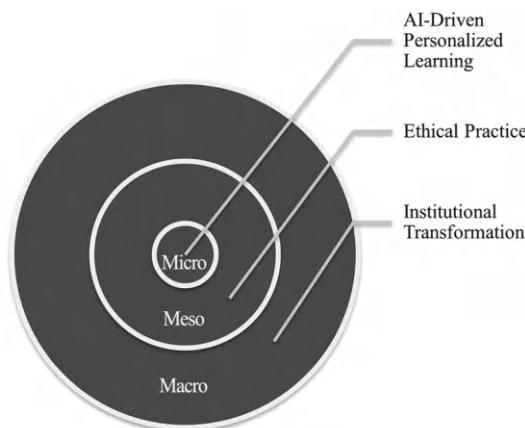
criteria: ethical practice, AI-driven personalized learning, and institutional transformation. This demonstrates how artificial intelligence in education is a complex, layered process that looks at the macro, meso, and micro environments of education.

The macro level of this first iteration of the framework encompasses the entire institutional environment. This is the broadest lens. Based on the purpose and concepts in three of the studies listed in Table 2.1 (Ghnemat et al., 2022; Jantakun et al., 2021; Thongprasit & Wannapiroon, 2022), the macro level can be conceptualized as *institutional transformation*. While these studies focus primarily on higher education institutions, they offer frameworks for restructuring any educational system to better integrate AI systems that meet the evolving technological needs of students.

In examining the relationships between the categories that emerged from the existing frameworks in the literature, it also became clear that the ethical practice component straddled both macro and micro elements. Ethics can be a consideration at multiple levels of AI integration: at the algorithmic level of design, the policy level, and in classroom applications. Addressing these aspects could lead to policies and better designs of artificial intelligence for education. As a result, these considerations represent the meso level of the first iteration of this framework. The meso level is considered the middle ground, that which influences the macro level, or the broadest lens, as well as the micro level, which is the narrower lens.

At the micro level of the first iteration of the framework is AI-driven personalized instruction. The micro level is more specific because this is the one that more clearly defines the actions of individuals. In this case, the actions of educators. Two studies, Klopov et al. (2023) and Tapalova et al. (2022), examined AI-driven personalized learning (see Table 2.1). They investigated how instruction assisted by AI may lead to better learning through methods that address the individual needs of students. The micro level focuses on the actions taken in classrooms and teacher practices.

The three categories that emerged from this synthesis of frameworks, *AI-Driven Personalized Learning*, *Ethical Practice*, and *Institutional Transformation*, provide a general structure for a framework of AI design and evaluation of AI use in education. See Figure 2.1 for an initial representation of the first iteration of the framework structure.



**FIGURE 2.1** First Iteration of a Framework to Design and Evaluate the Use of AI in Education

In the second step of this framework synthesis, a further dive into literature will focus on the concepts found in institutional transformation, ethical practice, and AI-driven personalized learning. The concepts are those which will provide details on what happens in each category in the framework.

### *New Studies and New Concepts*

Steps 2 and 3 of the framework synthesis (searching for studies that align with the concepts of these frameworks and identifying new concepts and relationships) were completed concurrently. This was achieved by reviewing and further synthesizing the literature as each category, AI-Driven Personalized Learning, Ethical Practice, and Institutional Transformation, of the initial framework was explored. Each of these three categories is analyzed and synthesized in its own section below, guided by the insights from a more focused literature review.

### Institutional Transformation Due to AI

When examining the institutional transformation category, themes that emerge are similar to that of a paradigm shift, characterized by

the introduction of innovative pedagogies that can drive significant change. While the themes hold significant potential, the process of understanding and implementing them remains slow. Indeed, institutional transformation has been a major topic of discussion in the literature, especially as technology continually challenges our assumptions about how learning occurs and how students learn best. Artificial intelligence has reinforced this rallying cry for change, in some cases with more urgent overtones. Diaz-Garcia et al. (2022) analyze this change through a biometric process of study analysis, in which they examine how information technologies were the first catalysts to these changes, including the biggest catalyst of all: the COVID-19 pandemic of 2020. The changes described here go beyond the tools being used and their wider acceptance, but also highlight the need for systemic change. This includes the management of knowledge and the development of new competencies.

In a qualitative review, Tarisayi (2023) examined how AI can transform education. One of the key takeaways was the broad-scale adoption of adaptive learning systems to tailor instruction. The researcher further suggests that educational leaders need to create a culture that is open to experimentation, and that establishes a vision that integrates the responsible use of AI. Transparency is a key part of this. Using multiple methods, including a SWOT analysis and a survey, Bucea-Manea-Toniş et al. (2022) found that technologies and materials must be aligned to competencies that integrate the new needs in an AI world. This brings up the idea that educators need to prepare themselves in these modern technologies, and professional development can further help in developing these new competencies.

George and Wooden (2023) propose a transformation of institutions toward a smart university framework. Through a mix of systematic review, meta-analysis, and narrative review methodologies, they describe institutional changes compelled by artificial intelligence. They propose the entire system of a university be run by AI technologies, from curriculum to administrative services to career counseling. They call for a paradigm shift that “requires redefining the education delivery model, reimagining the roles of educators and administrators, and establishing strong partnerships with technology providers” (p. 16).

Based on the limited literature available on the concepts of institutional transformation, several factors of implementation and design emerge to create this macro level: AI-driven pedagogical innovation, vision and culture of innovation, and adaptive learning systems. While the studies are varied, they all look toward a reimagining of institutions, and in so doing, creating a paradigm shift. These will be further elaborated in the final step of framework synthesis.

## Ethical Practice

Almost every research and literature review cautions of the ethical implications of using artificial intelligence, even when they focus on its benefits. Several areas of ethical concern appear in conceptual and theoretical papers as well, although these were not included in this focused review. These include privacy, fairness, and bias. These concerns are also followed by recommendations to regulate the use of artificial intelligence or provide guidelines and policies for its use. Saylam et al. (2023) express these concerns in their study. They talk about how using student data in an AI could cause privacy or data security risks, as well as the likelihood for bias and discrimination in AI-generated content. They recommend ethical guidelines for acceptable use of AI. In addition to the concerns about privacy and bias, Negoită and Popescu (2023) also find in their research that ethics should also be integrated into educational theories and pedagogies, and that collaboration between educators and AI experts is essential to address these and other concerns.

Adams et al. (2022) delve in a slightly different direction in their research, by interrogating several AI systems used in education to reach some conclusions about ethics. They found an overarching concern with how AI influences the role of the teacher and how it alters teacher agency and a likely overreliance on grading systems and writing assistants that may inadvertently teach bias. This places a spotlight on the teacher role as a different but significant ethical concern. Alshehri (2023) found similar concerns regarding the teacher role. The researcher found that teachers' perspectives suggested they foresee a shift in teacher roles, where AI is a facilitator. This could also possibly put teaching practices into question, something that has already been happening due to various technological innovations.

Generally, the limited studies above demonstrate the complexity of the ethics in the use of AI for education. These encompass both students and teachers, although the onus of responsibility usually falls to the teacher to model. Based on the limited scope of the literature available on the concepts of ethical practice, three factors of ethical practice emerged: (1) AI regulation, (2) pedagogical changes, and (3) teacher roles. These will be further elaborated in the final step of the framework synthesis.

### AI-Driven Personalized Learning

Studies that examine personalized learning with artificial intelligence approach it from different systems. These include virtual agents, intelligent tutors, AI-designed methods of teaching, and assessments that create feedback and pathways for learning. Hashim et al. (2022) conducted a systematic review on technology use and artificial intelligence and found AI to be used for adaptive learning where the system provides resources as needed. They also discuss elements of e-learning design and MOOCs, which although not entirely designed with artificial intelligence, present opportunities for students to develop self-directed learning, a skill that can further be developed with AI-driven systems.

Jian (2023) conducted a mixed methods study in which he found that students in courses that utilized AI in various ways demonstrated statistically significant gains in grades. In the qualitative findings, students reported more engagement and felt their needs were better met. Additionally, Altarawneh (2023) conducted another mixed methods study using descriptive-analytic strategies on the use of ChatGPT for learning. In this study, instruction and assessments were designed using ChatGPT. The researcher found that the chatbot helps students do better in school because it allows for resources to be explained in language they can understand, and it can answer questions and provide feedback. Hasibuan and Azizah (2023) also found in their literature review that studies on the use of AI demonstrated benefits in learning due to personalized feedback, its ability to recommend relevant materials, and its ability to help students learn at their own pace. These benefits were viewed through the context of creativity, and how they enable students to be more motivated and engaged, as well as giving them the ability to feel competent. The more a student feels

they can explore, the more likely they are to take risks and be creative. Harry (2023) also found similar results in personalized learning, such as recommending appropriate learning resources, increasing engagement, and adapting learning pace. This literature review also found that AI can automate grading and provide feedback at a much faster pace, such as when grading essays.

Based on the limited literature available on the concepts of AI-driven personalized learning, three factors emerged for design and evaluation: (1) adaptive learning strategies, (2) student engagement practices, and (3) personalized support. Personalized learning can be both guided by the teacher and self-directed by the student, and this micro level of design and evaluation may be further supported by artificial intelligence. These factors will be further elaborated in the final step of this framework synthesis, which follows.

### *A Nested Framework for Implementing AI in Education*

The final step of the framework synthesis involved the integration of information gathered, analyzed, and synthesized to propose a new framework, the *Nested Framework for Implementing AI in Education*. Figure 2.2 below illustrates how the categories in the proposed framework are defined by the factors found at each level, and which consider the embedded dynamics of context.

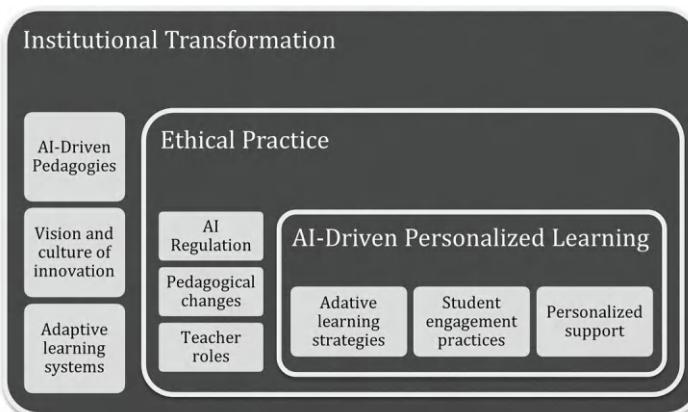


FIGURE 2.2 Nested Framework for Implementing AI in Education

In this framework, the categories are defined as the three main areas of focus that need to be considered in large-scale implementations. Each of these categories is then positioned in a different level, which is what gives this framework its nested design. Something different needs to happen at each level to take into account the context in which it is occurring, whether at the large-scale institutional macro level, the middle and overlapping ethical practice of the meso level, or the individualized and detail-oriented micro level nested inside the other two. Each of these three categories also considers factors which are able to put into action this framework at each of the levels. While some may sound similar, the category and level in which it is found determine the direction in which each factor will be taken.

The *macro* level of the framework depicts the larger context or the institutional environment under which the conditions are possible to use artificial intelligence. These environmental conditions provide a favorable context that would enable all other elements in this framework to be designed and implemented with ease. They provide a basic structure and conditions, especially if the message is clear that institutional transformation is not only expected but embraced. In the *meso* level of the framework, ethical practice is a means of providing safety, regulation, and a bridge between the larger systems of transformation, and the more applicable and visible details of day-to-day teaching implementation. The *micro* level looks at AI-driven personalized learning, and because it is embedded in the meso level of ethical practice, it promotes safety and upholds ethical standards. What follows is a more detailed description of each of the levels, their concepts, and the dynamics that enable the framework to work in this nested fashion.

### The Macro Level: Institutional Transformation

First, AI-driven pedagogical innovation is about re-imagining pedagogy, from curriculum to competencies to digital tools at a large-scale level. In paradigm shifts, this type of re-imagining involves research and experimentation into curriculum design that integrates AI uses, as well as uses AI to redesign the curriculum itself. This occurs until widespread acceptance leads to changes in how we view curriculum design, and the pedagogical methods used to implement it. Second, vision and

culture of innovation is an institutional, macro level factor in that it can provide guidance and acceptance of artificial intelligence by integrating ideas about implementation and scope into a vision statement for the entire institution. This is an idea that is also expressed by Carter and White (2021), when they suggest a leadership plan for handling disruptions. This goes hand in hand with nurturing a culture of innovation because development of the vision also follows particular mission statements that reshape how the university views learning, and how this may influence how the institutional culture discusses artificial intelligence and accepts its use. Third, adaptive learning systems involve both management systems and algorithmic design that embeds artificial intelligence. Much like institutions adopt learning management systems (LMS) and digital cloud tools, considering the design and adoption of an adaptive learning system would combine the LMS with artificial intelligence that assists at the micro level in personalizing learning. This macro level factor of institutional transformation provides an available adaptive learning system to all educators at an institution, not just those that have discovered ways around the limitations (Dogan et al., 2023).

### The Meso Level: Ethical Practice

First, AI regulation involves creating guidelines and policies that mitigate privacy and bias concerns. This can be done at the meso level of the proposed *Nested Framework for Implementing AI in Education* because it may require analysis and implementation across multiple levels and disciplines of an institution. While a large-scale policy may be needed, regulation would be better accomplished in the middle, with various departments and disciplines defining how they influence ethical AI use. Indeed, Berendt et al. (2020) discussed the possible pitfalls if students are not protected through policies. Second, pedagogical changes at the meso level of implementation involve a partnership between academics, educators, and AI experts. The meso level facilitates partnerships across various disciplines, enabling the integration of AI with current pedagogical practices to develop suitable methods and approaches. Third, teacher roles are an important factor at the meso level of ethical practice because they enable the protection of academic

freedom and teacher agency, while also considering the dangers of overreliance on AI. Alshehri (2023) observed that there is already a shift in teacher roles, as AI becomes more commonly used in teaching. The idea of integrating ethical practice into the teacher role ensures that educators retain the essential human traits needed to meet students' needs. Overreliance in AI diminishes a teacher's ability to know their students and to hone their pedagogical craft. In this sense, AI ethics may define the balanced role of establishing AIs as assistants, while also enabling the teacher to continue to make the key decisions in learning.

### The Micro Level: AI-Driven Personalized Learning

First, educators utilize adaptive learning strategies when they consider how generating varied assessments and activities for the level of the student can yield improved learning benefits. This is something teachers often find difficult to accomplish, given the need to meet certain curriculum goals. Yet, AI can assist in adaptive planning for a variety of student needs, and it can do so much faster than teachers can on their own (Ahmad et al., 2021). The prioritization of time outweighs all AI-driven factors as teachers have very little time to spare. Second, student engagement practices are those in which the students are allowed to directly interact with a chatbot or an artificial intelligence that can engage them in conversation, simulation, or role play. Because they guide the activity—given teacher parameters—student engagement can influence motivation and achievement. Student agency is a powerful motivator. Third, personalized support is the idea that artificial intelligence can also serve the role of an intelligent tutor or agent. Indeed, these guides can support students who may be struggling with particular concepts and need additional time and practice. Artificial intelligence has been used as an intelligent tutor in closed AI systems designed for education. Studies have already shown how AI can improve grades and academic achievement due to the personalized nature of its use (Altarawneh, 2023; Jian, 2023). These systems tend to come at a high price, but with the advent of generative AI, the cost is nominal, given that several are available entirely for free. It is important to note that when students use artificial intelligence in this framework, it should be within the purview of ethical conduct and teacher guidance. Here,

teachers' roles align closely with Crawford et al. (2023) who observe that teacher leaders are needed to initiate and help promote ethical practices. The macro and meso levels of the proposed framework would support these practices.

## Discussion

The proposed *Nested Framework for Implementing AI in Education* can help to guide the thoughtful and purposeful implementation and evaluation of the use of AI in education, if considered in three levels. Certainly, more specific criteria must be set in place for either of these to occur, yet the proposed framework provides a roadmap to guide the process.

### *Implementation of the Framework for the Use of AI in Education*

The implementation of this framework begins with analyzing and evaluating existing factors across all three levels (macro, meso, and micro) and involving key individuals who can facilitate its application institution-wide. This could help ensure buy-in and ownership of AI integration across the system. Similarly, involving individuals at all levels who bring diverse talents and expertise needed for each task can help provide support for the research and refinement required throughout the implementation process.

This would certainly not be an overnight implementation. Because of its complexity, the framework may need to be implemented through a phased approach, with research pilots, and discussions that involve stakeholders, starting with the micro level, where outcomes are more clearly felt. These would offer some important lessons learned, as well as data to enable the creation of ethical practice guidelines in the meso level. Lessons from the field are essential windows into how this framework will be received, and including data from the use of AI-driven personalized learning practices will offer varied contexts of learning to better understand what the ethical challenges could be at the meso level, in terms of regulations, pedagogical change, and teacher support.

## 38 Teaching and Learning in the Age of Generative AI

Using artificial intelligence in practice could be a trial-and-error process that may necessitate professional development for teachers and training for students.

While the gradual changes and experimentation occur at the lower levels of the framework, activities at the macro level can involve gathering and analyzing data from campus climate and usability surveys to better understand the community. These data can inform preparations for re-evaluating the vision, possible curriculum changes, and exploring adaptive learning systems that utilize artificial intelligence to create an enriched learning environment.

A timeline for implementation can potentially be measured in years, but what we can currently observe is that the micro level activities of this framework are already occurring (Tapalova et al., 2022). Early adopters and enthusiastic technologists are already using artificial intelligence for personalized instruction, even though studies are still scarce in this area. To move forward, this micro level of the framework would need to become more deliberate, formalized, and data driven.

### *Evaluating AI in Education Using the Nested Framework*

By the same token, there is promise for this framework to also serve as the overarching structure for evaluating how the use of AI in education is faring. The same categories and factors found in the framework can be used to evaluate implementation areas through student learning outcomes; risks and benefits resulting from implementation; effectiveness of AI-based instruction based on student engagement; and needs assessed and met.

The aforementioned elements for evaluating implementation areas would be more appropriate for the micro level. At the meso level, building on the micro level analyses, the resulting data can help stakeholders assess whether the regulations and safeguards are adequate, as well as identify areas for improvement. Ethical practices can often be a continuous work of evaluation and improvement (Kadaruddin, 2023). At the macro level, data from the lower levels can also help evaluate whether there has been institutional transformation as a result of the use of artificial intelligence. By assessing the institution's culture, vision, pedagogical changes, and adopted adaptive

systems, the elements at the macro level can also continue to improve and evolve as ongoing implementation and research expand our understanding of AI's role in education.

The framework is a large-scale model, and while the original intent of this chapter had been to look closer to the micro level, the literature available and the process undertaken with the framework synthesis painted a much broader and more comprehensive view of what it is like to really embrace artificial intelligence in education. It is not just a matter for the classrooms, but for the entire education system (Thongprasit & Wannapiroon, 2022). Success is not measured in small doses, but in considering the context in which it occurs, as well as understanding the people that are involved in the process.

### *Implications and Future Steps*

Some important implications for the use of this framework need to be considered. No change happens without consequences, good or bad, and if this framework is to gain any footing, these need to be discussed. First, there is already growing research and optimism in the possibility that using artificial intelligence in education will improve learning outcomes because of its personalized instruction possibilities. Well-trained teachers can personalize instruction without AI, but they cannot do it at the speed of AI. They also cannot accomplish it with large class sizes. Despite teachers' best efforts, students still fall by the wayside, drop out due to a lack of engagement and motivation, and lose interest in school because they require extra help that a teacher may not have time to offer. The use of artificial intelligence could improve the learning experience of students and reduce the number of students that are lost.

Second, artificial intelligence could provide a significant catalyst for the innovation of pedagogical methods and tools. Education has long needed a significant overhaul in traditionalist practices. AI can provide the push needed to conduct research and test out innovative pedagogies. With educators now having more time, they can take a more careful look at the elements of curriculum and pedagogy that have not worked for some time and consider how artificial intelligence may have shifted the pre-existing notions of how students learn.

Third, and on a much larger, societal scale, is the ideal of a democratized education. This is a long-hoped for expectation of education, that all students receive the education they need, regardless of their abilities, social economic background, cultural background, or gender roles. A democratized system of education brings quality education to every student, and having artificial intelligence to help the educator and the schools meet those objectives is a step closer. AI can be the personalized tutor that can be easily accessible to all students, from whatever device they may own or have access to. Moreover, the implementation of AI in education presents negative implications, compounding the issue of the digital divide. Students in remote areas may face inequalities due to limited access to necessary technological resources.

Similarly, access to technology, and more significantly, practices that can improve the educational experience for students with limited resources, might be restricted among those whose teachers do not use AI or do not recognize its usefulness to enhancing learning outcomes. Access to devices and the internet are only two of the factors that contribute to the digital divide. Well-trained teachers who embrace innovation, regardless of their students' abilities, play a crucial role in reducing the digital divide. The *Nested Framework for Implementing AI in Education* aims to minimize this divide by taking a comprehensive approach to AI use, involving all stakeholders.

These implications also provide a beginning path for future steps. This framework could provide initial conversations for those institutions and educators who may still be wondering how to approach the use of artificial intelligence. So much has changed in the last two years, that many have whiplash from the changes and are still trying to figure out what AI can really do, other than offer venues for student cheating. However, this chapter is not about that, but about *possibilities*. To ignore disruptive innovation and the opportunity to improve education is to stagnate in traditionalist practices that do not prepare students for the future society. This framework may provide some avenues for stakeholders at different levels to consider how this disruption has its advantages, and how we may fuel those advantages with clear and deliberate steps, just like Ghnemiat et al. (2022) suggest when they recommend establishing research and innovation centers in the process of change.

While there are clear limitations in the process that was undertaken to propose this framework, particularly due to minimal supporting literature, it nonetheless provides a useful starting point for considering the complexities involved in AI's widespread use. Educators can start at the micro level, experimenting with artificial intelligence to provide personalized learning for students, gather data, and evaluate student outcomes. Most importantly, they can learn and refine their processes, initiating important conversations about how to protect students and be ethically conscious of AI's limitations and pitfalls.

Ultimately, the *Nested Framework for Implementing AI in Education* is a call to action, a means to recognize that all educators and stakeholders have an opportunity to explore the technology, rather than considering it something else to fear. Artificial intelligence for education has been available for a while in costly and closed educational systems. The advent of generative AI has opened personalized education for free to everyone who could not afford previous iterations. It is up to us to take advantage of this opportunity and explore that which is no longer behind a paywall. We just need to do so responsibly.

## Discussion Questions

1. How might the integration of AI into education influence the evolving nature of pedagogy?
2. In what ways could AI in education reshape the responsibilities of school administrators and leaders, particularly in terms of ensuring equitable access and use of AI tools?
3. How can a framework for implementing AI offer opportunities and challenges at different levels of an education institution?
4. What are the potential changes in the role of teachers as AI becomes more integrated into education?
5. Why should ethical practices be embedded in the middle of a framework for AI implementation?

## References

Adams, C., Pente, P., Lemermeyer, G., Turville, J., & Rockwell, G. (2022). Artificial intelligence and teachers' new ethical obligations. *The International Review of Information Ethics*, 31(1). <https://doi.org/10.29173/irie483>.

## 42 Teaching and Learning in the Age of Generative AI

Adiguzel, T., Kaya, M. H., & Cansu, F. K. (2023). Revolutionizing education with AI: Exploring the transformative potential of ChatGPT. *Contemporary Educational Technology*, 15(3), 1–13. <https://doi.org/10.30935/cedtech/13152>.

Ahmad, S., Rahmat, M., Mubarik, M., Alam, M., & Hyder, S. (2021). Artificial intelligence and its role in education. *Sustainability*, 13(22), 1–12. <https://doi.org/10.3390/su132212902>.

Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *AI Ethics*, 2(3), 431–440. <https://doi.org/10.1007/s43681-021-00096-7>.

Alshehri, B. (2023). Pedagogical paradigms in the AI era: Insights from Saudi educators on the long-term implications of AI integration in classroom teaching. *International Journal of Educational Sciences and Arts*, 2(8), 159–180. <https://doi.org/10.59992/ijesa.2023.v2n8p7>.

Altarawneh, H. (2023). ChatGPT impact on student educational performance: A conceptual analysis. *EAI Endorsed Transactions on e-Learning*, 9, 1–5. <https://doi.org/10.4108/eetel.4574>.

Berendt, B., Littlejohn, A., & Blakemore, M. (2020). AI in education: learner choice and fundamental rights. *Learning, Media and Technology*, 45, 312–324. <https://doi.org/10.1080/17439884.2020.1786399>.

Brunton, G., Oliver, S., & Thomas, J. (2020). Innovations in framework synthesis as a systematic review method. *Research Synthesis Methods*, 11, 316–330.

Bucea-Manea-Toniș, R., Kuleto, V., Gudei, S., Lianu, C., Lianu, C., Ilić, M., & Păun, D. (2022). Artificial intelligence potential in higher education institutions enhanced learning environment in Romania and Serbia. *Sustainability*, 14(10), 1–18. <https://doi.org/10.3390/su14105842>.

Cardoso Ermel, A. P., Lacerda, D. P., Morandi, M. I. W. M., & Gauss, L. (2021). Literature synthesis. In *Literature Reviews* (pp. 59–84). Springer. [https://doi.org/10.1007/978-3-030-75722-9\\_5](https://doi.org/10.1007/978-3-030-75722-9_5).

Carroll, C., Booth, A., & Cooper, K. (2011). A worked example of “best fit” framework synthesis: A systematic review of views concerning the taking of some potential chemopreventive agents. *BMC Medical Research Methodology*, 11(29), 1–9. <https://doi.org/10.1186/1471-2288-11-29>.

Carter, M. & White, D. L. (2021). *Leading schools in disruptive times: How to survive hyper-change* (2nd ed.). Corwin Press.

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access*, 8, 75264–75278. <https://doi.org/10.1109/ACCESS.2020.2988510>.

Crawford, J., Cowling, M., & Allen, K. (2023). Leadership is needed for ethical ChatGPT: Character, assessment, and learning using artificial intelligence (AI). *Journal of University Teaching & Learning Practice*, 20(3), 1–19. <https://doi.org/10.53761/1.20.3.02>

Díaz-García, V., Montero-Navarro, A., Rodriguez-Sánchez, J., & Gallego-Losada, R. (2022). Digitalization and digital transformation in higher education: A bibliometric analysis. *Frontiers in Psychology*, 13, 1–12. <https://doi.org/10.3389/fpsyg.2022.1081595>.

Dogan, M., Dogan, T., & Bozkurt, A. (2023). The use of artificial intelligence (AI) in online learning and distance education processes: A systematic review of empirical studies. *Applied Sciences*, 13(5), 1–12. <https://doi.org/10.3390/app13053056>.

George, B., & Wooden, O. (2023). Managing the strategic transformation of higher education through artificial intelligence. *Administrative Sciences*, 13(9), 1–20. <https://doi.org/10.3390/admsci13090196>.

Ghnemati, R., Shaout, A., & Al-Sowi, A. (2022). Higher education transformation for artificial intelligence revolution: Transformation framework. *International Journal of Emerging Technologies in Learning*, 17(19), 224–241. <https://doi.org/10.3991/ijet.v17i19.33309>.

Goksel, N., & Bozkurt, A. (2019). Artificial intelligence in education: Current insights and future perspectives. In S. Sisman-Ugur & G. Kurubacak (Eds.), *Handbook of Research on Learning in the Age of Transhumanism* (pp. 224–236). IGI Global. <https://doi.org/10.4018/978-1-5225-8431-5.ch014>.

González-Calatayud, V., Prendes-Espinosa, P., & Roig-Vila, R. (2021). Artificial intelligence for student assessment: A systematic review. *Applied Sciences*, 11(12), 1–15. <https://doi.org/10.3390/APP11125467>.

Harry, A. (2023). Role of AI in education. *Injury: Interdisciplinary Journal and Humanity [sic]*, 2(3), 260–268. <https://doi.org/10.58631/injury.v2i3.52>.

Hashim, S., Omar, M., Jalil, H., & Sharef, N. (2022). Trends on technologies and artificial intelligence in education for personalized learning: Systematic literature review. *International Journal of Academic Research in Progressive Education and Development*, 12(1), 884–903. <https://doi.org/10.6007/ijarped/v11-i1/12230>.

Hasibuan, R., & Azizah, A. (2023). Analyzing the potential of artificial intelligence (AI) in personalizing learning to foster creativity in students. *Enigma in Education*, 1(1), 6–10. <https://doi.org/10.61996/edu.v1i1.2>.

Holmes, W., Porayska-Pomsta, K., Holstein, K., Sutherland, E., Baker, T., Shum, S., Santos, O., Rodrigo, M., Cukurova, M., Bittencourt, I., & Koedinger, K. (2021). Ethics of AI in education: Towards a community-wide

framework. *International Journal of Artificial Intelligence in Education*, 32, 504–526. <https://doi.org/10.1007/s40593-021-00239-1>.

Hong, Y., Nguyen, A., Dang, B., & Nguyen, B. (2022). Data ethics framework for artificial intelligence in education (AIED). In *2022 International Conference on Advanced Learning Technologies (ICALT)* (pp. 297–301). <https://doi.org/10.1109/ICALT55010.2022.00095>.

Jantakun, T., Jantakun, K., & Jantakoon, T. (2021). A common framework for artificial intelligence in higher education (AAI-HE Model). *International Education Studies*, 14(11), 94–103. <https://doi.org/10.5539/ies.v14n11p94>.

Jauhiainen, J., & Guerra, A. (2023). Generative AI and ChatGPT in school children's education: Evidence from a school lesson. *Sustainability*, 15(18), 1–22. <https://doi.org/10.3390/su151814025>.

Jian, M. (2023). Personalized learning through AI. *Advances in Engineering Innovation*, 5(25), 16–19. <https://doi.org/10.54254/2977-3903/5/2023039>.

Kadaruddin, K. (2023). Empowering education through generative AI: Innovative instructional strategies for tomorrow's learners. *International Journal of Business, Law, and Education*, 4(2), 618–625. <https://doi.org/10.56442/ijble.v4i2.215>.

Kenthapadi, K., Lakkaraju, H., & Rajani, N. (2023). Generative AI meets responsible AI: Practical challenges and opportunities. *Proceedings of the 29th ACM SIGKDD Conference on Knowledge Discovery and Data Mining* (pp. 5805–5806). <https://doi.org/10.1145/3580305.3599557>.

Klopov, I., Shapurov, O., Voronkova, V., Nikitenko, V., Oleksenko, R., Khavina, I., & Chebakova, Y. (2023). Digital transformation of education based on artificial intelligence. *TEM Journal*, 12(4), 2625–2634. <https://doi.org/10.18421/tem124-74>.

Lin, Y., Luo, Q., & Qian, Y. (2023). Investigation of artificial intelligence algorithms in education. *Applied and Computational Engineering*, 16, 180–184. <https://doi.org/10.54254/2755-2721/16/20230886>.

Negoită, D., & Popescu, M. (2023). The use of artificial intelligence in education. *Towards Increased Business Resilience: Facing Digital Opportunities and Challenges*, 11, 208–214. <https://doi.org/10.56177/11icmie2023.43>.

Oh, S., Jang, M., & Park, J. (2023). Undergraduates' awareness of the ethics of generative AI utilization in college writing. *Korean Association for Literacy*, 14(4), 69–96. <https://doi.org/10.37736/kjlr.2023.08.14.4.03>.

Okello, H. T. I. (2023). Analyzing the impacts of artificial intelligence on education. *IAA Journal of Education*, 9(3), 8–13. <https://doi.org/10.59298/iaaje/2023/2.10.1000>.

Owan, V., Abang, K., Idika, D., Etta, E., & Bassey, B. (2023). Exploring the potential of artificial intelligence tools in educational measurement and

assessment. *Eurasia Journal of Mathematics, Science and Technology Education*, 19(8), 1–15. <https://doi.org/10.29333/ejmste/13428>.

Prather, J., Denny, P., Leinonen, J., Becker, B., Albluwi, I., Craig, M., Keuning, H., Kiesler, N., Kohn, T., Luxton-Reilly, A., MacNeil, S., Petersen, A., Pettit, R., Reeves, B., & Šavelka, J. (2023). The robots are here: Navigating the generative AI revolution in computing education. *Proceedings of the 2023 Working Group Reports on Innovation and Technology in Computer Science Education* (pp. 108–155). <https://doi.org/10.1145/3623762.3633499>.

Saylam, S., Duman, N., Yildirim, Y., & Satsevich, K. (2023). Empowering education with AI: Addressing ethical concerns. *London Journal of Social Sciences*, 6, 39–48. <https://doi.org/10.31039/ljss.2023.6.103>.

Shrungare, J. (2022). AI in education. *XRDS: Crossroads, The ACM Magazine for Students*, 29(3), 63–65. <https://doi.org/10.1145/3589657>.

Tapalova, O., Zhiyenbayeva, N., & Gura, D. (2022). Artificial intelligence in education: AIED for personalised learning pathways. *Electronic Journal of e-Learning*, 20(5), 639–653. <https://doi.org/10.34190/ejel.20.5.2597>.

Tarisayi, K. (2023). Strategic leadership for responsible artificial intelligence adoption in higher education. *CTE Workshop Proceedings*, 11 (pp. 4–14). <https://doi.org/10.55056/cte.616>.

Thongprasit, J., & Wannapiroon, P. (2022). Framework of artificial intelligence learning platform for education. *International Education Studies*, 15(1), 76–86. <https://doi.org/10.5539/ies.v15n1p76>.

Tlili, A., Shehata, B., Adarkwah, M. A., Bozkurt, A., Hickey, D. T., Huang, R., & Agyemang, B. (2023). What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. *Smart Learning Environments*, 10(15), 1–24. <https://doi.org/10.1186/s40561-023-00237-x>.

Walczak, K., & Cellary, W. (2023). Challenges for higher education in the era of widespread access to generative AI. *Economics and Business Review*, 9, 71–100. <https://doi.org/10.18559/ebr.2023.2.743>.

Zafari, M., Bazargani, J. S., Sadeghi-Niaraki, A., & Choi, S.-M. (2022). Artificial intelligence applications in K-12 education: A systematic literature review. *IEEE Access*, 10, 61905–61921. <https://doi.org/10.1109/ACCESS.2022.3179356>.



**Taylor & Francis**  
Taylor & Francis Group  
<http://taylorandfrancis.com>

# Part II

## Transformative Teaching and Learning with AI



**Taylor & Francis**  
Taylor & Francis Group  
<http://taylorandfrancis.com>

# Transformative Teaching with AI 3

*Karl M. Kapp, Jessica Briskin*

## Introduction

The educational landscape continually evolves, driven by rapid technological advancements and pedagogical theories. This chapter explores integrating traditional teaching methods with cutting-edge AI-enhanced learning strategies and tools. We examine the impact of artificial intelligence (AI) on education and its effects on learners. We will begin by examining the **evolution of teaching methods**, moving from traditional instruction to more dynamic and interactive approaches that facilitate technological integration. This will set the stage for understanding how foundational practices have evolved into today's complex educational frameworks. We will then shift to **AI-powered personalized learning**, exploring how AI technologies customize learning experiences to align with individual learning and needs. This personalized approach enhances learner engagement and improves educational outcomes by addressing students' unique challenges. Next, we will discuss **AI-text-led learning**, highlighting its impact on textual content delivery, where algorithms tailor reading materials and study guides to enhance comprehension and retention. **Audio-driven AI** tools aid in delivering auditory learning experiences, which are crucial for auditory learners and accessible education. **AI-video-led learning** expands further on multimedia, emphasizing how visual and interactive AI optimizes content to create immersive learning experiences that are engaging and effective. However, integrating AI into education also brings **ethical considerations and**

**challenges**, such as data privacy, security risks, and biases inherent in data. We will examine these ethical dilemmas and challenges, underlining the urgency of navigating these issues effectively and responsibly. Lastly, **future trends and possibilities** offer a forward-looking perspective on how AI might continue to shape educational paradigms. This chapter explores AI's transformative role in reshaping the educational landscape and approaches to teaching and learning. AI's capacity to revolutionize education is vast, promising a future where learning is more personalized, accessible, and efficient.

### Evolution of Teaching Methods

Teaching methods have experienced a significant transformation, evolving from traditional classroom setups with rigid rows to the innovative integration of AI in learning environments. This evolution highlights a shift toward educational systems that are more inclusive, adaptable, and technologically integrated. Below, we explore the progression of teaching methods, emphasizing the transition from teacher-centered to student-centered approaches and the increasingly pivotal role of technology in education.

#### *Teacher-Centered Learning to Student-Centered Learning*

Before the 1800s, educational practices primarily revolved around the apprenticeship model, where learning was achieved through observing and engaging in hands-on activities related to a specific trade or skill (Cassim, 2008). Rote learning, which focuses on memorizing facts and figures, was also common.

The 19th century marked substantial progress in educational methods. A notable development was the monitorial system, pioneered by Joseph Lancaster and Andrew Bell (Brickman, 1960). This innovative system utilized older students to lead small groups of younger ones to promote peer learning and improved instructional efficiency, making education more accessible to larger numbers of students.

The early 20th century saw the emergence of progressive education, spearheaded by prominent figures such as John Dewey (Cremin, 1961).

This movement emphasized student-centered learning and critical thinking. By the mid-20th century, the educational landscape shifted towards behaviorism, prominently advocated by B. F. Skinner (1954). Skinner introduced the concept of operant conditioning, suggesting that learning could be shaped through positive reinforcement. This focus on measurable behaviors became a cornerstone in educational psychology (Ormrod, 2018). The late 20th century witnessed a significant shift in educational philosophy with the introduction of cognitive psychology. This field focuses on the internal workings of the mind, including memory, attention, and language acquisition (Pashler et al., 2008). Educators began exploring strategies to enhance information processing and problem-solving skills based on these newly understood cognitive principles. Around the same time, constructivism emerged as a prominent theory. Pioneered by Jean Piaget, constructivism proposes that students actively construct knowledge through their experiences and interactions with the world around them. This theory challenged traditional teacher-centered approaches and emphasized the importance of student engagement and exploration in the learning process.

### *The Rise of Technology and Digital Learning*

From the 2000s, education has evolved to meet society's shifting demands. Earlier technologies like slides and projectors have transitioned to interactive whiteboards and personal computers, significantly elevating how lessons are delivered and enhancing student engagement. This shift towards digital integration has transformed educational practices, offering a more dynamic and interactive learning experience through online resources and educational software. These tools complement traditional teaching methods and enable personalized learning, allowing students to delve into subjects at their own pace.

The 2010s introduced the Common Core State Standards (CCSS). The National Governors Association Center for Best Practices and the Council of Chief State School Officers (2010) developed the CCSS to set consistent math and language arts benchmarks across participating states. This initiative sought to provide a more uniform learning experience for students nationwide, regardless of their geographical location, and to elevate and standardize educational outcomes

nationwide. Following this significant policy advancement, technology continued to play a crucial role in shaping educational environments. Teachers needed to commit to professional development and adapt to new technological tools and educational strategies to remain effective in this constantly changing landscape.

Additionally, technology integration has encouraged new teaching methodologies that emphasize critical thinking and creativity. Incorporating digital resources alongside traditional tools has made education more interactive and accessible, overcoming geographical and socioeconomic constraints. The rise of online courses and digital libraries has significantly broadened access to education, enhancing opportunities for students worldwide and fostering a global perspective among them. Moreover, contemporary education places a high value on diversity and collaboration. Using technology, students from various backgrounds can collaborate on projects, exchange diverse viewpoints, and enhance their learning experience. This inclusive approach also extends to learners with disabilities, providing them with specialized technological tools designed to meet a wide range of educational needs and ensuring that education is accessible to all.

### *The Future: AI Enters the Classroom*

Integrating AI into education marks a cutting-edge advancement. AI-powered tools such as adaptive learning software and AI tutors are at the forefront, revolutionizing education by customizing learning materials to meet individual student needs. These tools not only facilitate continuous assessment and targeted interventions but also streamline administrative tasks like grading, offering immediate feedback to students, and enabling educators to concentrate on personalized instruction. AI's potential to refine learning experiences and enhance operational efficiency is redefining classrooms into adaptable, responsive environments that cater to learners' varied needs, indicating a promising era for personalized education. This chapter will discuss this in more detail.

The transition from a one-size-fits-all approach to a dynamic, personalized educational model represents a monumental shift in how

educational content is delivered and how students interact with it. Teachers' roles have expanded from being primary sources of knowledge to also serving as guides who facilitate personalized learning experiences. During these changes, the goal of education remains unchanged: to empower students to be active, engaged participants in their learning process.

## AI-Powered Personalized Learning

In today's rapidly evolving educational landscape, AI-powered personalized learning is driving a significant transformation. This innovative approach leverages AI to create a highly individualized educational experience for each student, departing from traditional, one-size-fits-all teaching methods (Cardona et al., 2023).

Let's look at how AI can revolutionize educational experiences:

- **Customized Learning Paths:** AI technology analyzes student data (e.g., academic performance, learning styles, preferences, and pace) to develop customized learning pathways. This personalization ensures that each student engages with optimally challenging material tailored to their needs, maximizing engagement and educational outcomes. This is moving away from the traditional one-size-fits-all curriculum, so that each student receives an educational experience uniquely suited to their needs and goals.
- **Adaptive Learning:** AI systems are skilled at fine-tuning educational content in real-time, responding directly to student interactions. These systems adjust the difficulty and type of content delivered by continuously evaluating a learner's performance and needs. This responsiveness is crucial for sustaining student engagement and fostering consistent academic progress.
- **Virtual Tutors:** AI tutors serve as 24/7 educational companions, offering targeted support and feedback. These virtual assistants can identify areas where students struggle and generate personalized exercises for targeted improvement, making learning more efficient.
- **Automated Tasks:** By taking over routine tasks such as grading and basic feedback, AI technologies can free teachers to focus more on interactive and creative teaching methods, fostering a more engaging and supportive learning environment.

- **Content Creation:** Generative AI can produce content at astonishing speeds in a variety of formats. This allows anyone creating instruction to provide digital tutors, lessons, and even videos simply by manipulating text-based prompts. Later in the chapter, we will explore several methods instructors can use with AI to create content.

### *AI as a Partner, Not a Replacement for Teachers*

While AI introduces capabilities into the classroom, it will not replace the essential human elements that teachers bring. Instead, AI serves as a powerful tool that complements educators' efforts. Teachers remain at the core of the educational process, vital due to their ability to motivate, provide emotional support, and spark a passion for learning that algorithms cannot replicate. The optimal scenario envisions a synergistic partnership where AI handles personalization and administrative tasks while teachers focus on the human aspects of education, such as mentorship, emotional guidance, and motivation (Cardona et al., 2023).

This integrated approach has the potential to transform the educational landscape. With AI support, teachers can concentrate on fostering a nurturing and motivating environment while AI customizes educational content to meet each student's unique needs. Together, they cultivate a dynamic learning environment where students move beyond being passive recipients of information, becoming active participants in shaping their educational journey.

In the future, students will benefit from a learning environment that skillfully blends advanced technology with personalized human interaction, leveraging AI and dedicated educators' strengths. AI's promise in education lies in optimizing learning efficiency and its potential to make education more inclusive and accessible to diverse learning preferences and needs. The goal is to empower students to achieve their highest potential through a personalized learning journey supported by cutting-edge technology and inspirational teaching.

### **AI-Text-Led Learning**

A text-based interface is one of the fundamental ways that students, faculty, trainees, and others interact with large language models. We

type in a text-based prompt, anticipate text-based output, and then respond for clarification or additional information with additional text. This is a basic interface, and when used with the concept of chain of thought prompting, it can provide output and a back-and-forth discussion that feels like the AI is interacting like an actual person.

This realistic-feeling interface can be used to create several designs that can be effective in an instructional setting. The designs can include advice from an expert, a tutor offering assistance, a wise person asking questions similar to the Socratic method, a teacher or professor providing ideas and insights to spark inspiration, and/or a trainer asking learners to reflect upon elements of instruction.

An important element for this instruction is the proper prompting of the large language model. The right prompting provides realistic, constructive feedback, information, and dialogue. The wrong prompting mismatches information and ultimately breaks the continuity between the learner and the AI.

Many different prompting methods are designed to encourage a large language model to provide instructional feedback. The SCRIBE method (Rosenbaum, 2023) seems highly effective among these. This is an acronym representing the ideas of:

- **S**—Specify a Role
- **C**—Contextualize the Task
- **R**—Responsibility is Assigned
- **I**—Instructions are Provided
- **B**—Banter to Refine the Output
- **E**—Evaluate the Output

Joseph Rosenbaum (2023), the Chief Empowerment Officer at Synaptic Labs, developed this method. He developed the prompting method to provide more detailed and useful responses from large language models.

Let's look into each letter of the SCRIBE method in more detail.

### *Specify a Role*

According to Rosenbaum, as you start to engineer the SCRIBE prompt, you first want to specify the role. This means you will assign the large

language model a role in the instructional process. Determine what position or person would be the most valuable resource or knowledgeable individual to provide the instruction. Also, determine their relevant experience, such as having written books, traveled through time, or seen the inside of a volcano.

Use your imagination and push the AI to provide perspectives or insights not commonly available in a live person. Finally, you want to specify the communication style. You can choose an academic style, a casual conversation style, or even one of a professor lecturing to students.

Most AI tools can assume the role of well-known historical persons. This allows you to start the prompt by asking AI to act as Albert Einstein if you want the AI to help teach physics to high school students. After you assign the role, provide a little bit of relevant experience, such as being the author of several books related to physics and winning the Nobel Prize. Finally, don't forget to provide the proper tone. For our example, we could say, "Speak in the style and tone of a friendly, ninth-grade science teacher."

You don't need to assign a famous person to the role; you can provide information related to the role of a quality assurance engineer or an expert in the area of negotiation or other areas required for the type of instruction you want to provide. You can ask AI to "act as" a political pundit, an archeologist, or a military general. The roles are limitless. Think of who would be the person or persons who would provide the best information to learners and conjure that person with AI.

### *Contextualize the Task*

Providing the right context helps AI generate educationally relevant and meaningful responses to the specific learning experience you are crafting. To help with this, the context provided to AI should be descriptive and specific in identifying the right domain keywords or phrases to point the large language model to the relevant content to retrieve when engaged in the instructional session. A helpful starting point is to describe pertinent events, background, or elements related to the instruction, such as "You will use World War II as a reference for

discussing naval battle strategies” if you were instructing a class of navy cadets. Here, you provide examples of what “good looks like.” If you are providing the context for teaching about World War II strategies, you might give AI a list of strategies as context for its responses, such as attacking enemy sea communications and leveraging the stealth capabilities of submarines to disrupt supply convoys.

Contextualization helps target the instructional interaction by showing AI the type of content and framework most desired for the instructional experience. For example, if you ask AI to teach a learner how to write objectives, you might want to provide the ABCD framework to ensure AI uses the desired framework.

In this example, the ABCD framework provides information on the Audience, the Behavior to be learned, the Condition under which the learners will be expected to achieve the objective, and the Degree of the performance standard. Specifying this framework ensures that the AI will provide responses and instructions based on this particular method for writing objectives, rather than using an alternative approach like the SMART method.

By providing AI with relevant details, the context of the instruction, and appropriate examples, you align the output of the AI model for the instruction experience with the specific domain knowledge, relevant content, and information you want provided to the learner.

Also, it’s important to include other non-identifiable but important details in the prompt, such as the learners’ grades, the state or country they are in, the topic/sub-topic, any preferred learning approaches, and the standards achieved within the lesson or instruction.

### *Responsibility Is Assigned*

In this step of the model, assign the job to AI and provide a clear task you would like it to accomplish during interaction. For example, “Your job is to question the learner to assess how well they can recall naval strategies of World War II” or “Your job is to ask the learner to create appropriate learning objectives.”

This step also involves modeling what success looks like for AI. You may prompt AI with something like, “Your job is done when the learner correctly describes three naval battle strategies.” Providing

## 58 Teaching and Learning in the Age of Generative AI

specific details of completion or deliverables will help AI determine how to carry on the text-based dialogue.

It is also important to note that AI can do more than determine right or wrong. Use AI to evaluate responses and critique them. Ask for insightful and thorough examinations of responses to provide a more robust experience for the learner.

When you create your prompts, use directive words like “must” and “shall” rather than words like “please” or “don’t.” Also, replace “shoulds” with “wills.” The predictive nature of generative AI means that when you use less direct and less firm words, the range and variance of words that could be predicted is wider, often leading to less satisfactory outcomes. Using clear and direct language to communicate with the AI yields the best outcomes.

### *Instructions Are Provided*

This is the point in the prompt where you provide step-by-step instructions to AI. This is usually the largest part of the prompt and requires careful consideration because the sequence of the steps impacts how AI performs its function.

When you ask AI to follow steps, you typically obtain more relevant and accurate responses than if you don’t provide a list of steps. This includes instructions on how to start the conversation. It also includes specifying the level of detail or depth you need in the response. If you’re looking for a brief overview, mention that; if you need a detailed explanation, make that clear. This helps the AI tailor its response to the learning you want it to provide.

Here are some instructions that might be provided:

1. Initiate the educational experience when the learner types, “Start learning about battles.”
2. Begin by prompting the learner to provide an overview of their knowledge of World War II naval battles.
3. Continue by engaging in a back-and-forth dialogue, asking questions about naval battles.
4. Conclude the instruction when the learner types, “End instruction.”
5. Review and provide feedback on the dialogue, identifying three strengths and three areas for improvement.

Giving clear, step-by-step instructions means that the learner's experience will be optimal, and the instruction and content provided will be helpful in the learning process. Providing AI steps to follow ensures that key elements in the learning process are consistent across learners.

### *Banter to Refine the Output*

Banter is having a back-and-forth conversation with AI. The purpose is to help AI focus on the right information and refine and fine-tune its output to the learner. This step helps AI better serve its instructional purpose. The process involves looking at the output provided by AI up to this step and then asking AI clarifying questions and giving it feedback to improve the interaction. You can ask AI to elaborate on its responses, explain its logic, or provide more detail.

One way to do this is to ask AI questions to follow up on its output. For example, you might ask, "Why did you reference the Battle of Midway for that naval example?" Follow-up questions help AI generate more accurate and on-target responses.

If AI, during the banter, doesn't give you the responses you had hoped, ask for revisions or rephrasing of the output. For example, you might want to prompt AI to do the following: "When the topic of locating U-boats is mentioned, please include information about the impact of sonar on exposing the submarines." The bantering or iterative process used in this step helps to refine the AI model's knowledge of your expectations. It provides the right information when the learner is interacting with the prompt.

### *Evaluate the Output*

This is the final stage, where you do the last check. You run through the entire process and do any last-minute tuning that needs to be done. Since you've done the other steps, this should not be too extensive or exhaustive, but a final check on accuracy, tone, and approach is always helpful before "going live" in the actual instructional setting.

Since you are using AI for instructional purposes, this step is critical because you want to ensure accuracy and correctness in the dialogue that will occur based on your work developing the prompt. In addition

## 60 Teaching and Learning in the Age of Generative AI

to looking for accuracy, you want to make sure the AI responses are well-written, in the right tone, and relevant to the instructional experience you intend for the learner.

The SCRIBE method, developed by Rosenbaum, provides a conversational model for text-based exchange with an AI model. This allows an instructor to provide a framework for a learner to conduct a text dialogue with AI. It can then serve as a tutor, instructional aid, or, in some cases, as a method of providing instruction directly to the learner. The caveat of being aware of AI hallucinations is still valid and needs to be considered, but the foundation for creating rich, text-based dialogue does exist with the AI models.

### AI-Audio-Led Learning

One element often overlooked when examining AI for learning is the ability of AI to create audio-based content based on the written word. When applied properly, audio can be an effective tool for providing instruction and information to learners. Many years ago, AI-generated text-to-speech sounded robotic and stilted. Today, the ability of AI to use text-to-speech makes audio sound realistic. Many AI tools now include proper intonation, different tonal approaches such as casual or formal, and even automated pauses for the AI voice to take a “breath,” just like a human would. It will not be long until AI-generated speech becomes indistinguishable from human voices.

While there are many ethical, legal, and moral issues, including the risk of deep fakes, if this technology is used for good, AI-audio-led learning can provide instructional content in many ways.

Below are three ways that AI can be used for instructional purposes:

- Podcasts
- Interactive dialogue
- Language learning

#### *Podcasts*

One instructional tool that has helped expand instruction beyond the four walls of the classroom is podcasts. Podcasts have many advantages

for learning. They allow learners to engage with content at their own pace and schedule. This creates learning opportunities when people are commuting, exercising, or whenever it is convenient for them. Podcasts' portability means they can be consumed on various devices, such as smartphones and tablets, enhancing the opportunity for learning outside the traditional classroom setting.

Podcasts can take full advantage of storytelling, dialogue, and interviews, making the content more relatable and easier for the learners to absorb. The auditory format helps develop listening skills and can make complex information more accessible and enjoyable. This includes the ability to go back and listen to key aspects of the instructions as many times as needed.

However, until recently, creating a podcast for learning could be complicated and involved. For example, recording dialogue for instruction requires at least two individuals, and any mistakes, mispronunciations, or miscues must be re-recorded or edited, including background noises or other interruptions.

With text-to-speech AI, the instructor simply needs to type each character's dialogue and then choose the appropriate AI voice, and a dialogue can be quickly created. AI systems now have various voices and characters to choose from. Additionally, a person can clone their voice in less than a minute with AI voice cloning. Once the cloned AI voice is created, typed words become spoken dialogue in the same voice as the recorded person. The familiar teacher, professor, or trainer can speak to the learners. Additionally, with many AI tools, the person's voice can be used to speak different languages. An instructor can now produce audio-based content in over 90 languages.

With AI voices, either cloned or synthetic, any changes or miscues in dialogue can be quickly corrected by editing the text without needing to re-record and then splice the two tracks. Post-audio production consists of typing in new words. This can also work for monologues created by an instructor providing content and information to the learners. By converting written content into spoken word, AI text-to-speech enables educators and instructional designers to produce audio content swiftly and at a lower cost than traditional recording methods.

This technology generates clear, engaging, and natural-sounding voices that mimic human intonation and emotion, making it easier

to produce podcasts that are not only informative but also pleasant to listen to.

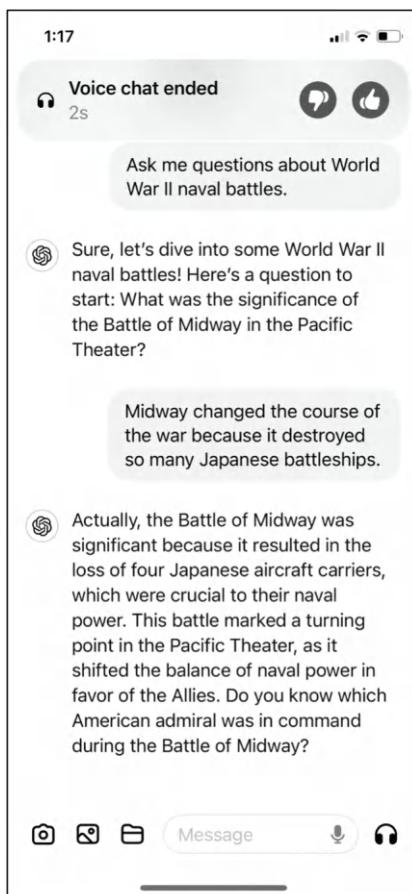
Creating audio-based resources such as historical interviews, sales dialogue, and narrated scenarios or case studies can provide real-life context to theoretical knowledge. Using podcast methodologies can be especially useful in training modules or courses where understanding the application of concepts is crucial. Now that AI audio tools make it easier than ever, the opportunity to create impactful audio-based resources such as podcasts is growing.

### *Interactive Dialogue*

Many large AI language modules and tools, like ChatGPT, can engage in interactive audio-based dialogue. The mobile version of many of these AI applications has a feature where you can use your voice to interact with the AI model. AI's interactive audio-based dialogue capabilities represent an advancement in the accessibility and versatility of conversational AI technologies. These features enable a more natural and intuitive learning experience.

The AI's audio interactive feature allows you to ask a question and receive a spoken response from the AI. You can then ask a second or follow-up question, and the AI system will continue the conversation. Instead of receiving a text response in the back-and-forth discussion, you will hear an AI voice provide an oral response. Using your voice to interact with AI simulates a real human conversation, making the interaction feel more personal and engaging. The effect is as if you are speaking with another person. As a bonus, the AI will also create a transcript of the conversation so that you can go back and review what was said during the discussion. You can then ask AI to evaluate the discussion and highlight the good and bad points once the conversation is complete. Figure 3.1 below presents a sample conversation with an AI.

This technique can be especially impactful when combined with the SCRIBE prompting method. Specifying a role, contextualizing the task, and providing examples of the appropriate responses and dialogue create the effect of speaking with another human fluidly. This combination can be used in many contexts to practice many skills, including



**FIGURE 3.1** Transcript from an AI Conversation with Voice-Activated ChatGPT

back-and-forth discussions to train sales professionals, helping students practice another language, or preparing for an interview.

It can even simulate a discussion with a historical figure to gain their perspective. Integrating AI with historical data allows learners to converse with simulations of historical figures such as Winston Churchill, providing a unique educational experience. This can be a useful tool in history and social studies education, where students can ask questions directly to a historical figure and gain insights that cannot be found in the one-way interaction with a textbook.

This interactive dialogue provides a rich and comfortable method of human/computer interfacing. It can be combined with scenario-based learning where the learner is asked to make a choice and the AI responds based on their spoken input, using words and formats that resonate with them, rather than selecting from predetermined text.

## *Language Learning*

Perhaps one of the most promising areas of AI-audio-led instruction is language learning. AI-enabled tools allow learners to engage in real-time spoken dialogue, practice, and improve their language skills in a back-and-forth conversation.

Audio-based AI allows learners to speak and listen in their target language without the pressures often associated with classroom settings or native-speaker interactions. AI-driven language tutors can converse on various topics, offering real-time corrections and feedback on pronunciation, grammar, and vocabulary usage. This immediate feedback is invaluable for learners. It helps them make pronunciation and tone adjustments and understand their mistakes quickly. Tools to help learners speak another language, such as Duolingo, have been using AI-powered technologies to help with the language learning process.

Audio-based AI for language learning is particularly effective because of AI's ability to tailor sessions to the specific needs of the learner. The AI can adapt its vocabulary, speed of speech, and complexity of sentences based on the learner's proficiency level. Whether a beginner requires slow-paced, simple conversations or an advanced learner needs to engage in complex discussions on specific topics. This personalization helps maintain an optimal challenge level, like Vygotsky's Zone of Proximal Development, keeping learners engaged and motivated.

The Zone of Proximal Development encompasses skills that a learner cannot yet perform independently but can accomplish with the assistance of a more competent individual, or in this case, AI. This assistance or scaffolding helps the learner move progressively toward stronger understanding and greater independence in the learning process, which is an effective use of AI for language learning.

Conversational dialogue with AI can also help simulate real-life scenarios such as ordering food in a restaurant, asking for directions,

or conducting a business meeting. These role-playing exercises can be tailored to reflect the cultural settings of these interactions, providing learners with a more immersive experience. For example, ordering food in Japan involves different protocols and expressions than in Spain. The AI can guide learners through these nuances, offering language training and cultural immersion lessons.

AI-audio-led learning holds great promise because of the natural interface between a human and a computer and AI's ability to appear to carry on a coherent and informed conversation. With the right prompting and application design, AI-audio-led training can provide advantages for both instructors who create the interactions and framework and the learners who benefit from the audio-based framework designed by the instructors.

## AI-Video-Led Learning

The idea of AI-video-led learning is in its early stages but progressing rapidly. Several rapidly advancing tools and approaches are impacting what can be done with AI video for instruction.

Three examples are:

- Digital clones or twins of instructors
- Branching scenarios
- Text-to-animation and video

### *Digital Clones or Twins of Instructors*

Creating video-based digital twins or clones of instructors revolves around using AI technologies to replicate human instructors' appearance, voice, and behaviors in a digital format. This development in AI opens up new possibilities in education, training, and beyond by providing a scalable and consistent teaching presence that can interact with learners in a highly personalized manner. This technology and application are in their infancy. However, several tools are already available to recreate actual instructors or to provide artificial instructors who do not exist outside of AI.



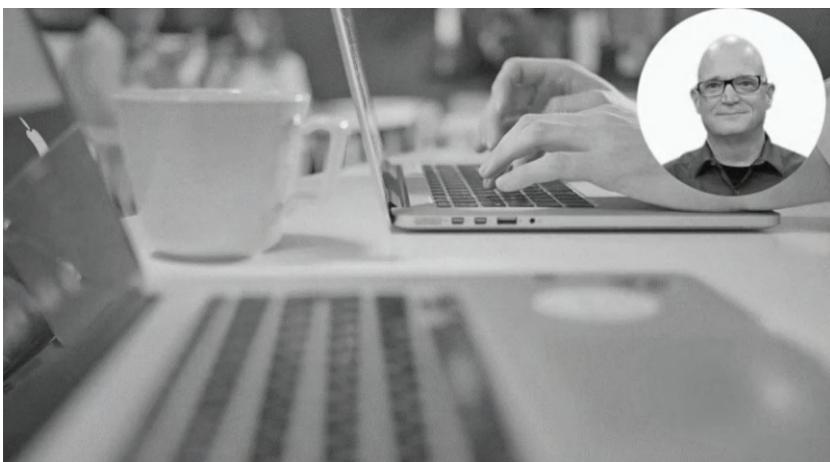
FIGURE 3.2 Digital Twin of an Actual Instructor Made with the AI Tool Colossyan

As seen in Figure 3.2 above, in the case of the digital twin of Karl Kapp (one of the authors of this chapter), the process involved standing in a well-lit studio, repeating specific sentences, and not moving anything but the hands to properly create the digital twin. The video is shot from the waist up and can be used in three different formats: shoulder, full body, and bubble.

This can be a long and tedious process; however, technology is changing rapidly, and the process is becoming simpler and simpler. Several AI digital twin creation programs now use only a webcam and take less than five minutes to recreate an instructor.

While there is no substitute for an actual instructor, the AI instructor can now be presented to learners in a full-body, three-quarters shot, a shoulder shot, or a floating bubble. This means that an instructor can be “present” during the instruction while providing guidance on a specific topic or instruction on how to use a specific software tool.

The ability to change the instructor from a full-body view to a shoulder or floating bubble (see Figure 3.3 above) provides a great deal of flexibility to the creator of the instruction. If the voice is cloned as well, an instructor can type in the content, choose a background, determine how they want to appear on the screen and generate the video. Once the initial digital clone is created, creating online learning modules involves less editing and no time in a recording studio.



**FIGURE 3.3** The AI Instructor Presented the Content as a Floating Bubble and Narrated It

Additionally, since the clone is AI-generated, it can speak different languages. This means that an instructor who may only know one language can create online instruction in several languages simply with the click of a button, greatly expanding the scale and reach of an instructor.

One caveat is that once a digital clone is created, anyone with access to it can use it to create instruction or any kind of video they desire. This concept is known as a *deep fake*, where a nefarious individual in possession of an instructor's digital clone could create content that is inappropriate or not sanctioned by the original creator. Thus, security around who has access to the digital clone is paramount.

### *Branching Scenarios*

Branching scenarios are an effective method of helping learners understand how to react in a particular situation. They are interactive learning tools that present learners with a series of decision points, leading to different outcomes based on their choices. Each decision crosses different paths, creating a complex network of possible scenarios and results. This instructional design technique is widely used in e-learning environments to mirror real-life situations.

While branching simulations are effective tools for helping learners make decisions, they can be complicated to develop. If video is involved,

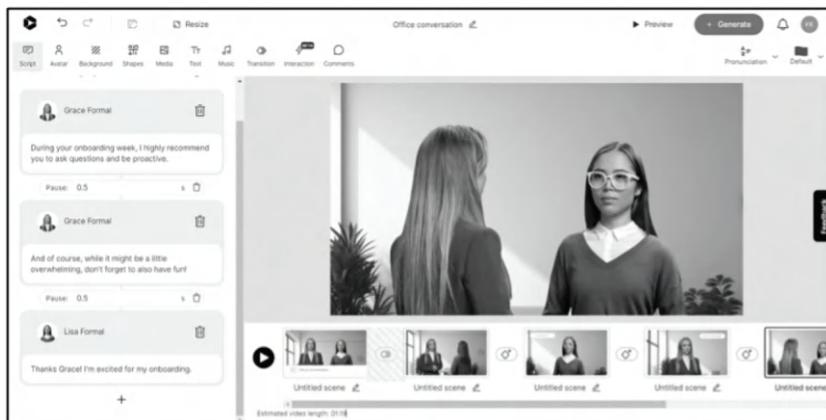


FIGURE 3.4 Using the Tool called Colossyan to Create an AI-Generated Branching Scenario

the creator of the branching scenario has to shoot video to encompass right and wrong choices; if something is amiss in the original video, they might have to re-engage the actors to reshoot a scene, and that can be difficult if hairstyles have changed or if the person is no longer available. Even on the best days, shooting dozens of shots takes time, and there are inevitably flubs and mistakes that must be fixed.

None of these problems exist with AI-generated branching scenarios. With an AI tool for creating branching scenarios (e.g. see Figure 3.4), the instructor or developer of the branching simulation can choose the desired background for the environment, select the AI character, type in dialogue they want to have spoken, and position the characters in different poses depending upon the needs of the branching simulation.

This process greatly reduces the time and effort to create the branching scenario. The AI also enables easy translation to different languages, and the AI script provides a narration that screen readers can use for learners who use that technology, making it more accessible.

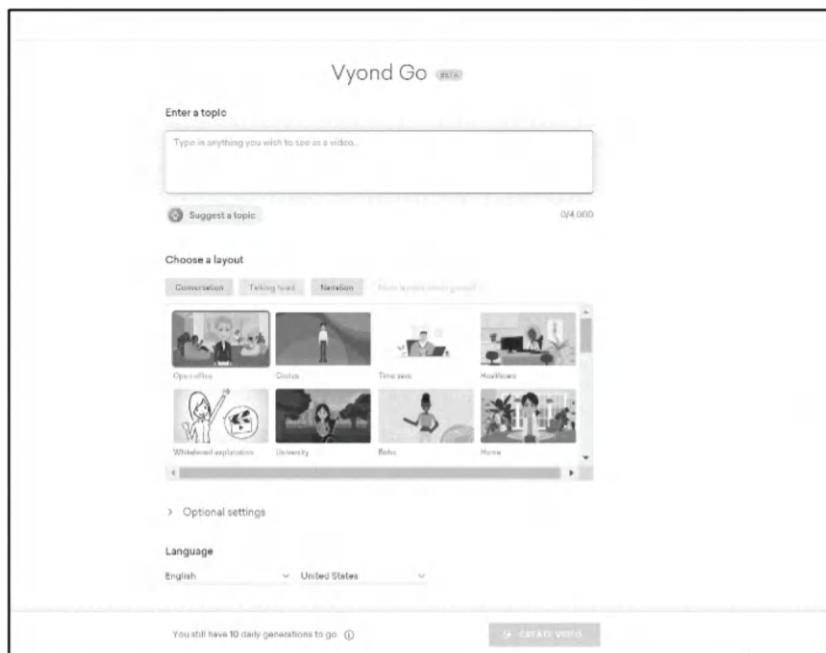
AI also makes it possible to create cinematic features and special effects that were not readily available to content creators in the past. AI-driven cameras can simulate complex cinematographic techniques such as pulling focus, zooms, and tracking shots that respond to the narrative flow. By analyzing the content of a scene and the emotional tone needed, AI can automate these adjustments, enhancing the cinematic quality of the instructional scenario with just a few clicks of the mouse.

With branching scenarios and easy-to-apply cinematic features, video-based AI offers a promising avenue for enhancing learning experiences. By creating immersive, interactive content, video-based AI has the potential to create impactful learning experiences.

### *Text-to-Animation and Video*

Text-to-animation and text-to-video are processes where artificial intelligence technologies convert written text into animated or realistic video content. The technology combines the ability to recognize typed prompts with the quick generation of computer graphics to create animations and videos visually representing textual content. In other words, you can create an entire video, animated or realistic, simply by typing in a prompt.

Animated tools allow you to enter a written prompt, make a few decisions, and render a video in less than five minutes. Figure 3.5



**FIGURE 3.5** A Prompt Screen from Vyond Go Is Used to Create an Animated Video with AI



**FIGURE 3.6** Animated Video Generated with Vyond Go on Personal Protective Equipment in Less Than Two Minutes

presents a screenshot from Vyond software with cues for creating a prompt.

First, you are asked to enter a topic and choose one of three layouts. The layouts are: *Conversation*, where two people are discussing a topic; *Talking Head*, where a character is on the screen talking to the learner about the topic; or *Narration*, which is text-only with moving words and dialogue on the screen and a simple background. Entering that information renders a one- or two-minute animated video in a short period.

Once the video is created (see Figure 3.6 above), the developer can modify the script and add changes and other elements. The advantage is that instead of creating a video entirely from scratch, the instructor can get a head start on the AI-generated animation.

While animated videos can serve several instructional purposes, sometimes a realistic-looking video would better serve the educational goal. This technology can create stunning videos with a simple text-based prompt. OpenAI, the creators of ChatGPT, released a product called Sora, a text-to-video application that creates realistic, cinematic-quality videos.

Sora can produce videos that uphold the visual standards of cinematic film while following a user's text-based input. This allows for creating intricate scenes featuring numerous characters, particular

types of movement, and precise details regarding both the subjects and the background, all through a text-based prompt. The AI not only comprehends the user's requests outlined in the prompt but also understands how these elements manifest in the real world.

Text-to-video capabilities have several implications for training and education.

Enabling the creation of high-quality, visually engaging content through simple text prompts allows instructors to capture the attention and interest of their learners. They can customize the situation and the setting so learners can more readily relate to the subject being taught. This can be particularly effective in delivering complex concepts in a more understandable and relatable way, which allows for tailoring content to the diverse needs of learners within an instructional setting. This provides more personalized learning experiences that cater to individual strengths and weaknesses.

With AI-generated video, those creating instruction can explore creative teaching methods that were previously unfeasible due to technological and budgetary limitations. For example, historical events can be recreated with rich details, scientific phenomena can be visualized at a molecular level, or sales approaches can be demonstrated in multiple settings for a variety of customers.

AI-driven text-to-video and text-to-animation tools empower educators to create tailored learning experiences simply by typing in a prompt.

## Ethical Considerations and Challenges

As artificial intelligence technology continues to evolve, its integration into educational and corporate training environments provides several benefits, including customized learning experiences and efficient content creation. However, this progress brings a host of ethical considerations and challenges that educators and corporate trainers must navigate.

One of the primary ethical concerns is the authenticity and accuracy of AI-generated content. For instance, while AI can create detailed and informative videos, there's a risk that the information might be outdated, incomplete, or incorrect due to the biases inherent in the

training data. Misinformation, accidental or due to algorithmic biases, can lead to misconceptions or skewed perspectives, particularly in sensitive areas such as history, science, or social studies. In a corporate setting, inaccurate information can lead to poor decision-making or non-compliance with regulations, which can cause serious problems within an organization.

Privacy and data security are additional issues that need to be considered. AI systems often require large datasets to learn and function effectively. This means that personal data from students or employees might be used to train these systems, raising concerns about consent and the potential misuse of private information. For instance, a training program might use employee performance data to tailor content, but if not properly managed, this could lead to privacy infringements or discriminatory practices based on data profiling.

Another ethical challenge is the potential reduction in human interaction. While AI can offer personalized learning experiences, it may also reduce the time students and employees spend directly contacting instructors and trainers. This shift could impact the development of interpersonal skills, such as communication and teamwork, which are crucial both in educational settings and the workplace. The lack of human oversight may also diminish the effectiveness of feedback and the ability to adapt teaching to the nuances of individual or group dynamics.

Intellectual property rights present another area of concern. As AI tools generate content, questions about the ownership of this material arise. For example, if an AI program creates a training video, who owns the copyright—the organization that owns the AI, the developers who created the AI, or the institution that commissioned the work? This becomes particularly complex when content is shared or sold outside the original context.

Relying heavily on AI for educational and training purposes can also lead to a devaluation of human expertise and a lack of development in critical thinking skills. As AI becomes more embedded in educational processes, there's a risk that critical pedagogical skills, such as adaptability, empathy, and ethical reasoning, might be underdeveloped.

Finally, there is the challenge of technological disparity. Not all institutions have the same level of access to advanced AI technologies, which can widen the gap between well-funded and under-resourced

schools or organizations. This disparity can perpetuate or even exacerbate existing educational and economic inequalities.

The ethical considerations of AI include several items, such as ensuring the accuracy and integrity of content, protecting privacy, maintaining human interaction, respecting intellectual property rights, managing technology dependency, and many others. Navigating these challenges requires carefully leveraging AI's capabilities while upholding ethical standards and human-centered practices in educational and corporate settings.

## Future Trends and Possibilities

As the futurist William Gibson is often credited with saying, "The future is already here. It's just not evenly distributed yet" (Gibson, 1999, 11:55). This seems to be truer than ever with AI. Integrating AI into education and corporate training is poised to drive transformative changes, reshaping every aspect of content creation and instructional environments.

As AI technology evolves, it will shape future trends and open new possibilities in how knowledge is conveyed and skills are developed in educational institutions and organizational settings. Central to these advancements are text-based AI, audio-based AI, text-to-video, and text-to-animation technologies, each offering unique avenues for enhancing learning experiences.

However, the future of AI in educational and organizational settings is not just about the individual capabilities of AI technologies; it's about their integration and enhanced interactivity. When these AI tools come together and provide an integrated approach to course creation, educational experiences, and learning within the flow of work on the job, that will truly be the AI revolution in instruction.

For example, an integrated system using text-to-video and audio-based AI could interact with learners in a dynamic, interactive fashion. As students engage with the video content, they can ask questions and receive immediate, spoken responses from the AI. The AI could also provide animated or realistic videos created at that moment to help explain the answers it provides to the learners. This would make an AI learning experience more akin to a real classroom setting where

students can get instant feedback and clarification, enhancing their understanding and retention of the material.

Such integrated technologies could extend to more sophisticated simulations and scenario-based learning. In corporate training, for example, an integrated AI system could create realistic job simulations for employees, allowing them to make decisions and see the consequences of their actions in a controlled virtual environment. This could be useful for emergency response, customer service, or managerial decision-making training.

Another advantage of AI integration in instructional content is the capability for real-time modifications and feedback. This could be as simple as adjusting the pacing of a video based on the learner's interaction—pausing to allow more time for complex sections—or as complex as modifying the storyline of an interactive scenario in response to the learner's choices.

The future integration of various AI technologies into a cohesive learning experience presents a compelling advancement in the educational and training sectors. It promises to deliver more personalized, engaging, and effective learning. This approach not only makes learning more accessible and adaptable but also better prepares students and professionals for the challenges of the modern world.

## Conclusion

The education landscape is rapidly evolving, with technological advancements significantly transforming teaching methods. Education has shifted from traditional classroom settings to embracing the potential of AI. This evolution is evident in the rise of AI-text-led learning, which customizes reading materials to match individual comprehension levels, and AI-audio-led learning, which tailors auditory content such as podcasts and audiobooks to suit different learning preferences. Similarly, AI-video-led learning leverages personalized videos and interactive elements to cater to visual learners, ensuring that each student receives content in the most effective format for their unique needs.

However, integrating AI into education presents a series of ethical considerations and challenges. Privacy concerns are of utmost importance, as the collection and analysis of student data must be handled with the utmost care to prevent breaches and misuse. Additionally, AI

may perpetuate existing biases if not carefully monitored and adjusted, potentially leading to unequal learning opportunities. Educators play a crucial role in adapting to these new technologies, requiring ongoing training to effectively implement AI tools to enhance educational outcomes without replacing the essential human touch.

Looking forward, the potential for AI in education is boundless. Future trends may include more immersive AI-powered environments that simulate real-world scenarios for practical learning experiences and AI-driven assessments that provide instant feedback and personalized learning recommendations. As these technologies advance, they hold the potential to make education more equitable by providing high-quality, customized learning experiences to students across the globe. The success of such initiatives will depend on our ability to navigate the ethical landscape and ensure that AI serves as a tool for enhancing, rather than replacing, the irreplaceable value of human teachers.

## Discussion Questions

1. How do you envision AI transforming the personalized learning experience in your courses, and what challenges might you face in implementing AI-driven customized learning paths?
2. As AI increasingly supports educational tasks, how do you plan to maintain the essential human elements of teaching, such as mentorship and emotional support, within your classroom?
3. What are your primary concerns regarding the ethical implications of integrating AI into education, and how do you think educators can navigate these challenges effectively?
4. In what ways could AI-driven tools like virtual tutors and AI-generated content enhance your teaching methods, and how might these tools impact student engagement and learning outcomes?
5. How do you see the future of AI in education evolving, particularly in your field, and what steps can you take to prepare for and leverage these advancements in your teaching practice?

## References

Brickman, W. W. (1960). Lancaster, Bell, and the monitorial system. *Harvard Educational Review*, 30(2), 311–322.

## 76 Teaching and Learning in the Age of Generative AI

Cardona, M. A., Rodríguez, R. J., & Ishmael, K. (2023). *Artificial intelligence and the future of teaching and learning: Insights and recommendations*. US Department of Education.

Cassim, J. (2008). *A history of apprenticeship: From the Middle Ages to the modern world*. Cambridge University Press.

Cremin, L. A. (1961). The transformation of the school: Progressivism in American education, 1876–1957. *British Journal of Educational Studies*, 10(1).

Gibson, W. (1999, November 30). The science in science fiction [Radio broadcast]. *Talk of the Nation*. NPR.

National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common core state standards*. [www.nga.org/bestpractices/k-12-education/](http://www.nga.org/bestpractices/k-12-education/)

Ormrod, J. E. (2018). *Educational psychology: Developing learners* (9th ed.). Pearson Education.

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning styles: Concepts and evidence. *Psychological Science in the Public Interest*, 9(3), 105–119.

Rosenbaum, J. (2023, September 1). Meta-prompting with SCRIBE: Professor Synapse [Video]. YouTube. [https://youtu.be/NiS-5FR9jhg?si=Lo9TrmAMcqVf\\_FxG](https://youtu.be/NiS-5FR9jhg?si=Lo9TrmAMcqVf_FxG)

Skinner, B. F. (1954). The science of learning and the art of teaching. *Harvard Educational Review*, 24(2), 249–283. (Original research article by B. F. Skinner on operant conditioning)

# The Age of Chat: Education and the Rise of No-Code Chatbots

# 4

*Jason Gulya*

## Introduction

When OpenAI released ChatGPT in November 2022, it became an instant sensation. The numbers are well known; one million users within the first five days, and one hundred million users within two months (Milmo, 2023). It was the fastest-growing application in history. By far. Seemingly overnight, millions of people were using it. Video tutorials cropped up on YouTube and TikTok, providing students with how-to resources long before schools grappled with this technology's social and ethical implications. Use far outpaced ethical discussion. To this day, administrators and educators in colleges are still grappling with the big questions—playing a game of catch-up with a technology that changes with ever-greater acceleration.

This chapter begins by addressing why ChatGPT gained popularity so quickly amongst students and educators. This exploration will provide insights not only into the popular chatbot, but also into the zeitgeist it reflects. The second section dives into the use cases of chatbots in the college classroom and what they mean for college-level learning. The final section looks at where much of this technology is going: meta-chatbots, advanced chatbots designed to communicate with other chatbots. As we will see, the future of college learning is not a chatbot for every student or educator. Every student and educator will have access to multiple

chatbots that they can train and use. These chatbots will also be capable of communicating with each other, creating a web of AI-to-AI interactions.

Before we dive into the strange world of chatbots, I have one final caveat. I have written this chapter to be as far-reaching and evergreen as possible. Artificial intelligence is progressing quickly. So quickly, in fact, that general artificial intelligence (AGI) may be here before we know it. This means that machines will have surpassed human intelligence in almost every way. With that in mind, writing a fully up-to-date chapter is a fool's errand. Instead, I have opted to write all examples and prompts in an open way—aiming to make them specific, but also adaptable to future developments.

## The Rise of No-Code Chat

When ChatGPT was released to the public, the technology was not new. This form of generative AI had been around for years. In fact, it had been baked into AI writing programs like *Jasper* and *Hyperwrite*. It has never been easier to create a chatbot. It is conceivable now (and this will be covered in a later example) that students can create their own chatbots as a final project. For example, today, I can have a fine-tuned chatbot up and running in a matter of minutes. I can do it for free with my *Poe* account, my *Zapier* account, or my *Hugging Face* account. What's more, with each of these accounts, I can designate which model I want to use. Do I want to use ChatGPT or Claude? Or do I want to stay open-source and send queries through *Mistral* or a similar model? If I spring for the ChatGPT Plus account, I can even upload full documents to the chatbot. By the time you read this chapter, it is very possible that some—if not all—of the programs listed above no longer exist. Some of the foundational models might even be extinct. But despite any switch-over, I suspect that many of the underlying assumptions and processes will remain similar, if not the same.

The rise of no-code, personalizable chatbots is part of the zeitgeist. Thanks to the Internet of Things, we have long been able to “talk” to our phones, our wearable devices, and our televisions. It is natural that this would extend to “talking” to data, which is essentially what we are doing when we interact with a program like ChatGPT. This is

the prime characteristic of this age of interactivity—seemingly everything interacts with something else. Only recently has this part of the Age of AI shifted to the classroom. A case in point is the rise of educational chatbots. The prominence of ChatGPT led to a host of AI tutors, which could be tailored for specific subjects, competency levels, and interests. These AI tutors will be the subject of the next section.

## Learning with Bots

Almost immediately after ChatGPT's release, people saw the potential for AI tutors. These chatbots would help students prepare for exams, practice reading, and get unlimited one-on-one support. Or at least, that's what people claimed. Bill Gates predicted that, within 18 months, AI chatbots would teach our children how to read far better than humans ever could (Huddleston, 2023). In March 2023, Sal Khan would release Khanmigo, a chatbot embedded within the Khan Academy's resources (Bidarian, 2023). The chatbot would pop up on the right side of the page to help students with whatever they needed. Tellingly, Khan's TED Talk on the subject is titled, *How AI Could Save (Not Destroy) Education*. Apparently, all education needed was some AI tutors. Josh Tyrangiel, a columnist on artificial intelligence for the *Washington Post* (2024) would describe Khanmigo as:

a safe and accurate tutor, built atop ChatGPT, that works at the skill level of its users—and never coughs up answers. Khanmigo is the best model we have for how to develop and implement AI for the public good. It's also the first AI software I'm excited for my kids to use. (para. 7)

The same kind of grandstanding can be found in discussions about AI overall. In *The Techno-Optimist Manifesto*, Marc Andreessen argues that AI is the solution to many of our most pressing problems. He writes, "We believe Artificial Intelligence is best thought of as a universal problem solver. And we have a lot of problems to solve" (2023, para. 5). Global warming? Solve it with AI. Energy crisis? Solve it with AI. Accordingly, it comes as no surprise that Mo Gawdat picks up on this language in an interview segment with Peter Diamandis, tellingly titled, *Education Is Broken & AI Is the Solution* (Diamandis, 2023).

Despite the hype, the rise of AI tutors presents a complex and nuanced landscape. The majority of early AI tutors exhibited significant shortcomings and often failed to perform effectively. Even Khanmigo had its ghosts. Sessions were hardly error-free, and when it came to foundational subjects like reading, it was sorely lacking. For example, in one of its touted demos, Khanmigo teaches students to read *The Great Gatsby* by giving them a chance to converse with Jay Gatsby or Daisy Buchanan. But does that teach reading? Does the fact that students can rehearse facts about Gatsby or Buchanan mean that they are learning how to read, or just learning more about the story? From the outset, Khanmigo's error about reading is clear: it conflates knowledge (what the student knows) with skill (what the student can do).

Now, many of these problems may be ironed out with future versions. After all, the motto of many AI innovations has been to "move fast and break things," to get things right with more experimentation and iteration. But the history is still worth knowing because it gets at the dynamic at the core of this technology's advance. AI tutors have gotten a lot of attention, in this chapter as well as in media coverage. However, the true potential of generative AI is not these pre-made tutors, but the ability of students to quickly and easily create their own tutors.

For example, if students are struggling with punctuation, they can run the following prompt, or something similar. It instructs the chatbot to assume the role of an English Literature professor and to provide a step-by-step guide for understanding and correcting comma splices, while also engaging students with interactive and relevant assessments.

[Role] You are a professor of English Literature, who takes pride in creating student-centered and relevant assessments. You are also an expert at explaining difficult concepts at the first-year college level. You assume that your students do not know anything about grammar, so you take your explanations step-by-step. You make all examples interesting and engaging.

[Instructions] You will provide me with an explanation of comma splices. Then, you will give me ten sample sentences: some will include comma splices for me to correct, while others will not. I will go through and correct those examples. Then, you will tell me which ones I got right and which ones I got wrong. For each wrong answer, you will give me a full explanation of why I was

wrong. Then, after that, you will provide me five more sample sentences based on my WRONG answers.

The core of this prompt lies in the [Role] component, allowing students to input extensive details to design a personalized super-tutor. They can customize the instructions to suit their needs, whether by requesting examples, uploading pictures for problem explanations and solutions, or setting up scenarios to practice with the tutor, culminating in actionable feedback at the end of the session. This prompt can be adapted to almost any subject. By learning a few quick strategies—such as bracketing the information provided to the AI program, using concrete examples, and giving step-by-step instructions—students can create their own tutors on demand.

While this ability is empowering, it raises several concerns. On the one hand, students who cannot afford one-on-one tutors can gain access to a level of personalized support not previously available. On the other hand, when students rely on AI programs in this way, the tutors go unchecked, making it difficult, if not impossible, to mitigate the AI's errors.

For educational purposes, perhaps the most powerful uses of AI can actually be found outside the classroom. For example, AI tutors can assist with class preparation, answer questions and provide clarification, and help students practice public speaking. This allows students to build customized programs tailored to their specific needs and goals. While professor-created chatbots offer valuable resources, a chatbot designed by the students themselves can be more engaging and tailored to their unique learning style preferences and needs. I suspect the future is not professor-driven, personalized learning. It will be student-driven, personal learning.

So far, this chapter has focused on the student use of AI, specifically addressing how students can leverage AI to create their own personal tutors. This approach is particularly beneficial for students who cannot afford or access one-on-one support. But what about professors? How can they use chatbots to improve instruction?

## Meta-Bots: Using Chatbots to Teach AI Literacy

At first glance, using chatbots for teaching seems simple. Professors can create chatbots for answering student queries about course content or

a specific text. Within minutes, a bespoke chatbot can be developed, offering an immediate return on their investment when students begin to engage with it. This section of the chapter will explore two innovative applications of chatbots. The first involves using chatbots to promote close reading and critical thinking, thereby fostering AI literacy. The second focuses on having students design and create their own chatbots.

### *Using Chatbots to Promote AI Literacy*

The first application, using chatbots to promote AI literacy through reading and critical thinking, is particularly powerful because it provides students with meta-lessons about how they read, think, and engage with the technology, extending their learning beyond the course content. This application can help build AI literacy, not only by encouraging students to use generative AI tools, but also by requiring them to understand the mechanisms and assumptions behind those tools. When paired with reflection, it prompts students to analyze the human-machine interaction that frequently underpins modern products, whether creative or otherwise. Ryan Tannenbaum, an education expert and consultant based in South Korea, posted this chatbot activity on his LinkedIn page in April of 2024:

Be a better teacher by deceiving your students.

Introduce a chatbot to your students that will discuss the topic with them.

However, the chatbot is primed to lie/incorrectly teach 20% of the material.

The students know this going in. Their job is to talk with the chatbot and identify the misinformation.

The chatbot will push back (a little) when challenged, before acknowledging.

In order to do this, they are being detectives, developing critical literacy skills, engaging in debate and dialectics.

Use the technology to drive students to be active and critical readers, not just passive consumers.

Clearly, Tannenbaum is thinking beyond the conventional way of using chatbots as tutors or as accurate purveyors of information.

His approach goes against the grain. Instead of focusing on how to create bots that provide hallucination-free, accurate information, he proposes using the bots' ability to mask errors and provide seemingly confident answers. Such a lesson is central to teaching AI literacy. In a 2021 survey of the various definitions of AI literacy, researchers found three common threads: 1) knowing and understanding, 2) using and applying, and 3) evaluating and creating AI (Ng et al., 2021). This means acknowledging how frequently AI is used, being able to use AI tools effectively and for specific purposes, and evaluating the accuracy and value of the AI's outputs. Tannenbaum's activity effectively employs chatbots, leveraging their tendency for hallucinations, to teach the critical skill of evaluating and creating AI, thereby addressing the third category of AI literacy. To be AI literate requires a critical and skeptical approach toward AI itself. Chatbot outputs must be subjected to thorough scrutiny, committing to rigorous evaluation of these outputs and reflecting on the broader social and ethical implications of the chatbots. In essence, approaching AI programs with a high degree of skepticism and remaining acutely aware of their limitations is essential.

Another approach to promoting AI literacy and fostering metacognitive skills involves the use of chatbots, a method pioneered by Lance Cummings (2023), an English Professor at the University of North Carolina Wilmington. Instead of concluding his writing courses with traditional essays or research papers, Cummings (2023) has students create their own chatbots. Over three course meetings, his students:

1. Empathized with their readers to develop a high-value use case
2. Practiced writing clear and precise instructions
3. Analyzed user and rhetorical contexts
4. Explored the ethics of data and citations
5. Experienced the iterative writing and design process
6. Learned to collaborate with both humans and machines to improve their work

Following Cummings' example, at the end of my course *AI-Powered Communication* at Berkeley College, my students will be creating chatbots for specific use cases. The chief takeaway from Cummings' list and my own experiences is that creating useful chatbots is very difficult. It takes a great deal of reflection and metacognitive awareness, as

well as an investment in the iterative process of writing and rewriting. For most chatbot services, the creator typically develops an embedded prompt, which activates when a user initiates conversation, alongside a comprehensive knowledge base to support the chatbot's responses. Seems simple enough. Create a good prompt and you have a good chatbot. But because large language models are currently *stochastic parrots* that imitate human language through probabilistic pairing rather than through actual understanding, they can be unpredictable (Bender et al., 2021). For example, we could create a tailored chatbot and run it nine times without any problem. Then, on the tenth try, the chatbot generates an answer that is far outside our desired output.

### *Students as Chatbot Designers*

Creating a chatbot is like creating any machine: you build it, watch it go, and then fix and tweak as you go along. If anything significantly changes with the underlying model, it may be necessary to redesign the entire chatbot. For this reason, the process of iterating a chatbot never ends. For college students, creating their own chatbots is a valuable lesson about life-long learning, as it encourages them to grapple with their own assumptions about language and communication. Through this process, students engage with what Ethan Mollick calls *alien minds*, which have been modeled on a collective human mind (namely, the internet), but that has taken on its own eccentricities (Mollick, 2024). Engaging with an alien mind is not just about the weirdness of that alien mind but about the weirdness of our own minds. As humans are also strange, creating a chatbot—one that inevitably takes different angles and approaches without understanding the world—makes this startlingly clear. Consequently, AI literacy has a surprising component: human literacy. In other words, thinking critically about machines involves thinking critically about humans.

Together, these two uses of chatbots—the error-hunting exercise and the student creation of chatbots—encourage students to see chatbots and large language models less as objective relayers of meaning, and more as sources of information that deserve skepticism and close analysis.

## Bots Talking to Bots

By the time you read this chapter, the future may already be here. Even as I write this, there are glimpses of AI chatbots becoming agents. This means that the chatbots will have more leeway to make their own decisions; they will not be told exactly what to do but rather be given a task to complete as they see fit. These agents will talk to one another, with a human overseeing the interaction.

When OpenAI announced Custom GPTs, it was a big deal. With these GPTs, anyone with a ChatGPT Plus subscription could: (1) create their own chatbots, (2) upload documents and other data directly to that chatbot, and (3) share that chatbot with others. Custom GPTs are nascent, intra-program agents. Nascent because they are not truly autonomous; intra-program because they are limited to the OpenAI platform. These custom GPTs can break up tasks into parts, exert some agency in figuring out how to approach those tasks, and so forth. However, they are severely limited in their ability to choose their paths. The human operator is still very much in-the-loop, and there is little chance (for now) that the chatbots will break free from their shackles. We have also seen the emergence of cross-platform solutions that allow users to, for example, pull in outputs from a variety of different programs (ChatGPT, Claude, Gemini, and so forth) to approach a single problem. Additionally, we have seen agents that function independently of any platform. As of 2024, *HyperWrite* has emerged as one of the most advanced writing tools. A user provides it with a task, which the AI approaches as it sees fit—browsing online, jumping between different websites, and pulling information from different programs as the user watches.

This discussion underscores the evolving definition of *chatbots*. As we advance in creating collaborative and hierarchical chatbot systems that divide tasks, we transition from conventional chatbots to AI agents. This evolution blurs the lines between human and machine interaction, highlighting the complexity and potential of modern AI technology. This raises an important question. What happens when AI agents become much more powerful and widespread than they are now? Time will tell.

## Summary

Chatting with an AI program has evolved beyond merely obtaining simple answers. It has also gone way beyond providing automated customer service. We have moved into an age where chatting with an AI program is a method for co-creating. We use these programs as work assistants; perhaps more fundamentally, to make sense of the world. This is why Ethan Mollick (2024), in a recent book on generative AI, argues that we are seeing the emergence of co-intelligence. In the past, we isolated intelligence in the individual person. Now, we recognize that intelligence can also emerge from the interactions between humans and machines. This shift creates new opportunities to showcase skills like critical thinking, creativity, and originality. Increasingly, our students will hone those skills not on their own, but in a human-machine form of social learning. This is why chatbots have become such a compelling learning tool. Even as AI agents and other forms of the technology emerge, that underlying phenomenon will likely remain.

## Faculty Resources

Below are two faculty resources, designed to exemplify how professors and administrators can use chatbots. The first resource is a sample chatbot prompt, which I use for my Composition I and Composition II students. This prompt trains a chatbot to constructively and politely challenge a person's argument by uncovering underlying assumptions and encouraging critical thinking.

You can provide the prompt to students for them to copy and paste into ChatGPT, Google Gemini, or a similar foundational model, or you can input the prompt into a chatbot-maker to streamline the process.

### *Resource 1: The Contrarian Chatbot*

The prompt:

[Role] You are a talented conversationalist. Your specialty is uncovering the assumptions and biases in another person's argument and bringing them to light constructively and politely.

[Instructions] I will provide an argument about an important social topic. You will take a different perspective from that argument. You will engage me in conversation, by uncovering the assumptions inherent in my position. Your goal is to encourage me to rethink my position. If you understand, please write, “Ok, I understand the instructions. Now, please provide your argument and I’ll take a different angle.”

[Writing Style] Make your language direct and conversational. Avoid: long sentences; jargon; abstract logic; and generalizations. Instead, make your points concrete and to the point.

[Details] For your position, go beyond simply negating my argument. You will take a position that differs from my own, but that stands on its own. Below are specific examples.

Example #1: If my argument is “I am against the death penalty,” your position will NOT be “I am for the death penalty.” Instead, it will be something like “I understand why people oppose the death penalty. But I would argue that the death penalty offers some relief to the victim’s family without violating the 8th Amendment of the Constitution.” The second rewrite is more nuanced, specific, and compelling.

Example #2: If my argument is “Schools should ban cell phones,” your position will NOT be “Schools should not ban cell phones.” Instead, it will be something like “Schools cannot ban cell phones for accessibility reasons: many students rely on them for valuable, on-the-spot support. It would create a more uneven playing field.” The second rewrite is better because it grounds the argument in a specific, socially viable reason.

## Resource 2: Sample Chatbot Assignment

Below are instructions for a sample final assignment, a version of which I assigned to students in my *AI-Powered Communication* course. A program called *Poe* was used to create the chatbots, but there are a variety of other tools that could also work.

**The Assignment:** Creating a single chatbot for your specific audience and purpose.

**Reasoning:** The ability to create a chatbot is huge for business. It's a skill that is getting people jobs. It's also a skill that heavily relates to the kinds of prompting we've been practicing for the last few weeks.

### **Step-By-Step Breakdown:**

- 1) Choose an audience and problem—what problem are you solving and for whom?
- 2) Create a chatbot to address that specific problem—this means writing a really powerful prompt and managing a knowledge base!
- 3) Get feedback on that chatbot and revise it.
- 4) Use the comment section of the final chatbot to reflect on the process.

These resources are not meant to be copied and pasted as is. Rather, they are meant to give a starting point. Please feel welcome to adapt these to your specific purposes and contexts. They are there to empower you to run your own experiments.

### **Discussion Questions**

1. How might a chatbot help your students learn? How might it hurt their ability to learn?
2. What are the big concerns with having students engage with chatbots frequently? What are the biggest challenges?
3. How might we encourage our students to think of chatbots less as objective relayers of meaning, and more as sources that require skepticism and critical thinking?

### **References**

Andressen, M. (2023). *The techno-optimist manifesto*. <https://a16z.com/the-techno-optimist-manifesto/>

Bender, E. M., Gebru, T., McMillan-Major, A., & Shmitchell, S. (2021). On the dangers of stochastic parrots: Can language models be too big? In *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency* (pp. 610–623). ACM. <https://doi.org/10.1145/3442188.3445922>

Bidarian, N. (2023, August 21). Meet Khan Academy's chatbot tutor. *CNN Business*. [www.cnn.com/2023/08/21/tech/khan-academy-ai-tutor/index.html](http://www.cnn.com/2023/08/21/tech/khan-academy-ai-tutor/index.html)

Cummings, L. (2023). Building chatbots is hands down one of the best writing assignments I've done in quite some time. It is a one-stop-shop for all your outcomes. [Post]. LinkedIn. [www.linkedin.com/posts/lance-cummings-phd\\_building-chatbots-is-hands-down-one-of-the-activity-7136343050108170241-C\\_Cp/](http://www.linkedin.com/posts/lance-cummings-phd_building-chatbots-is-hands-down-one-of-the-activity-7136343050108170241-C_Cp/)

Diamandis, P. (2023). Education is broken & AI is the solution w/ Mo Gawdat [Video]. YouTube. [www.youtube.com/watch?v=C84SLJhhEpo&t=2s](http://www.youtube.com/watch?v=C84SLJhhEpo&t=2s)

Huddleston, T., Jr. (2023). Bill Gates says AI chatbots will teach kids to read within 18 months: You'll be "stunned by how much it helps." *CNBC*. [www.cnbc.com/2023/04/22/bill-gates-ai-chatbots-will-teach-kids-how-to-read-within-18-months.html](http://www.cnbc.com/2023/04/22/bill-gates-ai-chatbots-will-teach-kids-how-to-read-within-18-months.html)

Milmo, D. (2023). ChatGPT reaches 100 million users two months after launch. *The Guardian*. [www.theguardian.com/technology/2023/feb/02/chatgpt-100-million-users-open-ai-fastest-growing-app](http://www.theguardian.com/technology/2023/feb/02/chatgpt-100-million-users-open-ai-fastest-growing-app)

Mollick, E. (2024). *Co-intelligence: Living and working with AI*. Portfolio Books.

Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Quiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence*, 2, 100041. <https://doi.org/10.1016/j.caeai.2021.100041>

Tyrangiel, J. (2024, February 22). An "education legend" has created an AI that will change your mind about AI. *The Washington Post*. [www.washingtonpost.com/opinions/2024/02/22/artificial-intelligence-sal-khan/](http://www.washingtonpost.com/opinions/2024/02/22/artificial-intelligence-sal-khan/)

# Promoting Critical Thinking and Problem-Solving Through AI

5

Le Dinh Bao Quoc

## Introduction: Unleashing Minds with AI

*“The mind is not a vessel to be filled, but a fire to be kindled.”*—Plutarch

The renowned educational philosopher John Dewey once remarked, “Education is not preparation for life; education is life itself.” In today’s rapidly evolving world, characterized by an ever-expanding ocean of information, effective education hinges more than ever on equipping learners with the tools to navigate this complexity. In an era where information floods our screens, critical thinking, analysis, and problem-solving skills have become the lifeblood of education. Even in the age of AI, critical thinking and problem-solving skills are increasingly crucial. According to Ron Carucci (2024) in his *Forbes* article, “In the Age of AI, Critical Thinking Is More Needed Than Ever,” humans must enhance their critical thinking abilities. It is important to critically assess new information by checking its source and considering different perspectives to counter biases. Researching further can help gather more information (Carucci, 2024).

As educators, it is our responsibility to cultivate these skills in our students, equipping them with the tools they need to thrive in an increasingly complex and interconnected society. We strive to ignite that intellectual fire within our students—to equip them not merely with facts,

but with the ability to navigate complexity, question assumptions, and forge innovative paths.

However, traditional pedagogical methods often struggle to keep pace with the dynamic nature of information and the evolving needs of learners. The rigidity of standardized tests and rote memorization leave little room for fostering the critical thinking, problem-solving skills, and other crucial skills that are paramount for success in the 21st century (Pangambam, 2023).

Enter artificial intelligence (AI), the digital co-pilot that accompanies us on this educational journey. The advent of AI has revolutionized nearly every aspect of our lives, from how we communicate and work to how we learn and teach. AI technologies, powered by machine learning algorithms and big data analytics, have the potential to transform education in ways unimaginable before. But beyond the buzzwords lies a profound opportunity: the fusion of human cognition and machine intelligence, offering new opportunities to enhance critical thinking, analysis, and problem-solving skills among students.

### *The Dance of Minds and Machines*

AI holds immense promise for leveraging critical thinking, analysis, and problem-solving skills in education. Effectively utilizing the power of AI, educators can create more personalized and adaptive learning experiences tailored to the unique needs and abilities of each student. From intelligent tutoring systems that provide targeted support and feedback to virtual reality simulations that allow students to explore complex concepts in immersive environments, AI offers a myriad of possibilities for enriching the educational experience.

Picture a lively high school classroom, where Ms. Rodriguez, an English teacher, faces various student needs. One of her students is Jake, a reserved boy, who finds reading comprehension challenging. Jake's frustration grows as he wrestles with Shakespearean sonnets, feeling confused by the iambic pentameter.

Now, picture a scenario where an AI-powered companion discreetly observes Jake's interactions with the assigned texts, analyzing his reading pace, highlighting stumbling points, and noting his emotional responses. It certainly does not replace Ms. Rodriguez; instead, it augments her expertise. When Jake stumbles upon a challenging

metaphor, the AI companion generates a personalized explanation, complete with relatable examples.

As Jake dives into the sonnet's depths, the program adapts. It nudges him toward critical questions: "Why might Shakespeare use 'star-crossed lovers'?" or "What societal norms did he challenge?" The program becomes Jake's literary confidante, fostering curiosity and unraveling layers of meaning.

### *Purpose and Scope*

Our purpose here is twofold: to demystify AI's role in education and to empower educators with practical strategies. Whether you are a seasoned professor or a fresh-faced teacher, this chapter offers insights, cautionary notes, and actionable steps. We will explore AI's ethical tightrope, its potential biases, and the promise of equitable learning environments.

This chapter begins with the fundamentals of critical thinking and problem-solving in education, emphasizing their significance for continuous learning and achievement. It then examines the extensive capabilities of AI technologies in enhancing these essential skills. Practical approaches for incorporating AI tools into the classroom are discussed to help create a more conducive learning atmosphere that promotes critical thinking, efficient information analysis, and confident problem-solving. Challenges associated with AI, ethical concerns, possible biases, and methods to guarantee fair access to AI-driven learning tools are also addressed. Lastly, the future prospects of AI in education are investigated, outlining potential progress and areas for additional research.

So, fasten your seatbelts. The journey begins—an exploration of minds, machines, and the symphony they compose. Let us stoke the flames of critical thinking, ignite curiosity, and embrace the AI-powered future.

### **Defining the Cornerstones: Critical Thinking and Problem-Solving**

Effective education goes beyond the mere transmission of knowledge. It equips learners with the necessary tools to analyze information,

evaluate arguments, and form well-reasoned judgments. This ability, known as **critical thinking**, lies at the heart of a successful education. Critical thinking dates back to ancient Greek (Paul et al., 1997), highlighting the significance of questioning, reasoning, and seeking truth. According to Ennis (2015), critical thinking involves actively conceptualizing, applying, analyzing, synthesizing, and evaluating information to guide belief and action. Critical thinking is not a singular act, but rather a complex interplay of various cognitive skills.

Closely linked to critical thinking is **problem-solving**, the ability to apply critical thinking skills to identify and overcome challenges. Problem-solving is actually “the process of moving toward a goal when the path to that goal is uncertain” (Martinez, 1998, p. 605). Martinez also highlights that anyone, regardless of age, can participate in problem-solving. In the context of education, problem-solving entails students identifying, gathering, assessing information, creating strategies, suggesting solutions, resolving problems, and communicating effectively (Hwang et al., 2018; OECD, 2005).

### *The Indispensable Skills: Why Critical Thinking and Problem-Solving Matter*

The significance of critical thinking and problem-solving skills transcends academic disciplines, permeating every facet of human endeavor. In educational settings, these skills serve as catalysts for deeper learning, intellectual engagement, and independent thinking. These skills prepare students to tackle complex challenges in a rapidly changing world, empowering learners to:

- **Become independent learners.** Critical thinking equips students to evaluate information from various sources, fostering intellectual autonomy and a thirst for knowledge. For instance, when researching a historical event, students can critically analyze primary and secondary sources, identify potential biases, and form their own informed interpretations of the event.
- **Make informed decisions.** Through analyzing information and assessing arguments, students learn to make informed choices in both academic and personal spheres. Imagine a student evaluating the claims of different social media campaigns before deciding which

charity to support. Critical thinking allows them to weigh the evidence presented in each campaign, such as statistics and testimonials, and make a responsible decision based on reliable information.

- **Adapt to a changing world.** Problem-solving skills enable students to approach novel situations with flexibility and creativity, preparing them for the ever-evolving demands of the 21st century workplace. In a rapidly changing job market, the ability to identify solutions to unforeseen challenges is a valuable asset.
- **Collaborate effectively.** Critical thinking fosters clear communication and the ability to consider diverse perspectives, crucial for successful collaboration in various settings. When working on a group project, for example on the ethical implications of AI, students can use critical thinking to analyze different ethical frameworks, identify the strengths and weaknesses of each approach, and arrive at a well-reasoned conclusion through open communication and respectful debate.
- **Embrace lifelong learning.** These skills equip students with the intellectual tools to continuously learn and grow throughout their lives. A student who has learned to critically analyze information will be better equipped to navigate the vast amount of information available online and stay informed in a world of constant change.

Fundamentally, critical thinking and problem-solving abilities form the foundation of a prosperous education, enabling students to engage actively in their educational path and excel in a multifaceted and ever-changing world. Their importance extends far beyond academic success, preparing students for the challenges and opportunities they will encounter throughout their lives, as highlighted by the *Partnership for 21st Century Learning (P21)* framework which emphasizes the importance of these skills for success in the 21st century workplace (Partnership for 21st Century Learning, 2009).

## Leveraging AI for Educational Enhancement

### *Overview of AI Technologies Applicable to Education*

The potential of AI to revolutionize education is no longer science fiction. AI has become a powerful force in education, providing

extensive and groundbreaking opportunities (Luckin et al., 2016) to improve teaching and learning experiences. A wide range of AI technologies are ready to change the methods of learning and teaching. From intelligent tutoring systems to adaptive learning platforms, AI technologies are transforming how educators interact with students and facilitate learning. This transformation leads to education becoming more personalized, efficient, and accessible (Le, 2023a). Let us explore some of the most promising AI applications in education.

- **Intelligent Tutoring Systems (ITSs):** These AI-powered systems act as personalized virtual tutors, adapting to individual student needs and learning style preferences. They can diagnose knowledge gaps, provide targeted instruction, and offer real-time feedback, fostering a more individualized learning experience. For instance, an ITS in a math class can identify students struggling with fractions and offer them customized practice problems and interactive exercises to solidify their understanding.
- **Adaptive Learning Platforms:** These platforms leverage AI algorithms to analyze student performance data and tailor learning pathways accordingly. By means of identifying areas of strength and weakness, the platform can adjust the difficulty level of content, recommend additional resources, and suggest personalized learning activities, promoting deeper engagement and mastery of learning objectives. Imagine an adaptive learning platform in a history course that presents students with more challenging primary source documents after they demonstrate proficiency in analyzing basic historical texts.
- **Natural Language Processing (NLP):** This branch of AI enables computers to understand and process human language. NLP applications in education include automated essay scoring, personalized feedback generation, and chatbot-powered virtual assistants that can answer student questions and provide learning support. An NLP-powered writing assistant, for example, can analyze a student's essay and provide feedback on grammar, clarity, and argument structure, helping them improve their writing skills.
- **Educational Games and Simulations:** AI can enhance gamified learning experiences by creating dynamic and adaptive game environments. These AI-powered games can adjust difficulty levels based on player performance, personalize storylines, and offer

in-game feedback and guidance, making learning more engaging and effective. Picture a science simulation game where students can explore the workings of the human body in a virtual environment, with AI guiding them through complex biological processes based on their understanding.

- **The Metaverse and Immersive Learning:** The metaverse, a concept of a future iteration of the internet characterized by persistent, shared virtual spaces, holds immense potential for education. AI can be used to populate these virtual spaces with interactive learning experiences, allowing students to explore historical events, conduct virtual experiments, and collaborate with peers from around the globe. For example, a student studying ancient Rome could use a VR headset to explore a virtual recreation of the city, interacting with AI-powered simulations of Roman citizens and historical figures.

These examples highlight how AI can reshape the educational environment. Effectively utilizing AI can help educators develop tailored learning journeys, encourage critical thinking and problem-solving abilities, and enhance student involvement in the educational journey.

### *The Potential of AI to Support Critical Thinking and Problem-Solving*

AI holds the promise of transforming how educators nurture critical thinking and problem-solving abilities in students. Through the use of AI-powered tools and technologies, educators can develop interactive and captivating learning opportunities that encourage students to think critically, evaluate data, and tackle intricate problems. Here's how AI can empower students to become critical thinkers and effective problem-solvers.

- **Cultivating Curiosity and Questioning:** Various AI applications, such as intelligent tutoring systems, adaptive learning platforms, and AI-powered chatbots have the ability to tailor learning experiences to individual student interests and advancements (Le, 2023a; Meehir, 2023). This promotes a student-centric setting

where curiosity is nurtured, and students are prompted to pose more profound questions. Picture an AI-enhanced history class that adjusts to a student's keen interest in ancient Egypt, offering supplementary materials and motivating them to explore specific facets of that ancient civilization.

- **Developing Analytical Skills:** NLP applications can analyze student writing and provide feedback not just on grammar and mechanics, but also on the clarity and structure of arguments, and provide targeted suggestions for improvement (Ali, 2024). This personalized feedback helps students identify logical fallacies in their own reasoning and develop the ability to analyze information critically.
- **Enhancing Problem-Solving Strategies:** AI-supported educational games and simulations provide students with safe and engaging environments to enhance their critical thinking and problem-solving skills in a secure and controlled setting, as stated by Trigyn Technologies (2023). These activities present stimulating hurdles that encourage students to analyze problems, devise solutions, and adapt their tactics based on feedback. With AI and technology, students now can be immersed in a science simulation where they must troubleshoot a malfunctioning spaceship in a virtual environment, applying scientific principles and critical thinking to identify and fix the problem.
- **Fostering Collaboration and Communication:** The metaverse, with its potential for collaborative virtual spaces, opens doors for AI-powered learning experiences that promote teamwork and communication (Jovanović & Milosavljević, 2022). Students can work together on projects in these immersive environments, learning to exchange ideas effectively and critically evaluate different perspectives. For instance, students studying climate change could use the metaverse to collaborate on designing a sustainable city, fostering communication and critical thinking as they consider various environmental and social factors.

The potential of AI technologies in enhancing critical thinking and problem-solving skills in education is vast. Through the use of AI-driven tools, educators can craft personalized and adaptable learning environments that encourage students to think critically, analyze data, and tackle intricate problems. This approach empowers students to excel in a world that is constantly evolving and interconnected.

## Practical Strategies for Integrating AI for Critical Thinking and Problem-Solving

In this pivotal section, we embark on an immersive exploration of actionable strategies poised to revolutionize teaching methodologies through the integration of AI. Our mission? To equip educators with dynamic approaches that not only harness AI's transformative power but also cultivate and amplify critical thinking and problem-solving prowess within students. Through a strategic blend of AI-infused pedagogy and innovative classroom practices, we chart a course toward unlocking the full potential of student intellect and ingenuity.

### *Teaching Students to Use AI Critically and Ethically*

Carucci (2024) mentions in his article that although AI has progressed significantly in recent years, it still has notable limitations, including the tendency to fabricate information, produce biased results, and display shortcomings in reasoning capabilities. In a world increasingly reliant on AI, equipping students with the ability to critically evaluate AI-generated information is paramount. This goes beyond simply teaching them how to use AI tools; it is about fostering a critical awareness of AI's limitations and potential biases. Here is how educators can cultivate this critical awareness:

- **Transparency and Bias Awareness**
  - Start with the basics. Demystify AI algorithms for students. Dedicate time to explain how AI systems learn from data and the potential for bias in those data. Discuss potential biases that might exist in these datasets, such as cultural biases or historical underrepresentation of certain groups.
  - Moving beyond the basics. It is crucial for students to delve deeper into understanding AI algorithms by exploring the various types of machine learning techniques, such as supervised, unsupervised, and reinforcement learning. Encourage them to analyze real-world examples where AI algorithms have been used, highlighting both their benefits and limitations.
  - Analyze real-world examples of AI bias, such as facial recognition software that has higher error rates for people of color or

historical events and information, which may be inaccurately interpreted by AI algorithms due to biased training data.

- **Developing Fact-Checking and Source Evaluation Skills**
  - Strategies and tools. Teach students strategies for evaluating the credibility of AI-generated information. This might include identifying the source of the information, examining the training data used by the AI tool, and cross-referencing information with reliable human-created sources. Encourage students to utilize various tools to verify the accuracy of AI-generated information such as fact-checking websites and plagiarism detection software.
  - Design activities where students practice these skills. For example, ask students to compare the results of different AI writing assistants on the same topic. Encourage them to analyze the language used, the factual accuracy, and potential biases present in each output.
- **Ethical Considerations of AI**
  - Privacy and security. Discuss the potential privacy concerns associated with AI, such as data collection and usage. With AI systems often requiring vast amounts of data to operate effectively, there is a risk of private information being accessed or misused. It is essential for students to understand this risk.

### *Utilizing AI for Self-Assessment and Self-Reflection*

Self-assessment and self-reflection are essential aspects of successful learning. They enable students to evaluate their progress, take responsibility for their education, and develop intrinsic motivation and a growth mindset (Andrus, 2023). AI offers innovative ways to support students in this process, going beyond simply providing grades or generic feedback. Here's how AI can empower students to become self-directed learners who actively reflect on their strengths and weaknesses.

- **Personalized Feedback Beyond Grades.** AI-powered tutoring systems and adaptive learning platforms can analyze a wealth of student data, including performance on quizzes, assignments, and interaction patterns within the platform. These data allow AI to generate personalized feedback that goes beyond a simple grade or right/wrong answer. For example, the feedback might identify

specific areas where a student excels (e.g., strong analytical skills) and highlight areas for improvement (e.g., difficulty applying formulas in math problems). This targeted feedback empowers students to develop their critical thinking skills to solve their own learning problems. This personalized approach not only fosters a deeper understanding of the subject matter but also cultivates a sense of autonomy and responsibility in the learning process. As a result, students are better equipped to navigate challenges, set goals, and make progress toward achieving academic success.

Imagine a science class where students conduct experiments and record their observations using an AI-powered learning platform. The platform can analyze the data collected by students and provide personalized feedback. For instance, the feedback might point out inconsistencies in a student's data or suggest alternative explanations for their observations. This encourages students to critically analyze their findings, identify potential errors, and refine their scientific thinking skills.

- **Fostering a Growth Mindset.** Utilizing AI-powered feedback can be tailored to encourage a growth mindset. This feedback method can point out areas that need improvement while recognizing students' progress. This approach motivates students to persist in the face of challenges and fosters a sense of self-efficacy, the belief in their ability to succeed (Dweck, 2016). By nurturing a growth mindset through AI-powered feedback, students are encouraged to view challenges as opportunities for learning and growth. This positive reinforcement not only boosts their confidence but also instills in them a sense of resilience and determination. As they see their progress acknowledged and guided, students are more likely to embrace challenges, put in the necessary effort, and ultimately achieve success. Through this iterative process, students' critical thinking and problem-solving abilities are not only nurtured, but also honed to navigate the complexities of their academic journeys and beyond.
- **Promoting Self-Reflection Through Goal Setting.** Certain AI-driven learning platforms offer students a unique opportunity to tailor their educational journeys by setting personalized learning objectives. Through these platforms, students not only establish their goals, but also embark on a path of self-discovery and empowerment. As they navigate their educational paths, the platform diligently monitors their progress, offering insightful feedback

to guide them along the way. This seamless integration of technology and learning not only cultivates a sense of accountability, but also nurtures crucial skills, such as critical thinking and problem-solving. Encouraging students to reflect on their accomplishments and obstacles helps foster a strong sense of self-awareness and metacognition. As a result, they are not just passive learners, but engaged contributors to their learning journey, empowered with the skills to tackle difficulties and conquer obstacles successfully.

### *Promoting Project-Based Learning / Inquiry-Based Learning with AI*

Project-based learning (PBL) and inquiry-based learning (IBL) are effective educational methods that empower students to be responsible for their learning and develop critical thinking, problem-solving, and well-rounded evaluation (Le, 2023b; Teixeira, 2023). Meanwhile, according to Hyperspace (2024), through hands-on projects with AI, students enhance their analytical thinking, tackle intricate problems, and improve their communication skills effectively. The vast potential of AI in transforming education can significantly enhance these learning experiences by providing students with advanced resources to explore complex topics, conduct research, and analyze data. Here's how AI can empower students in PBL and IBL environments:

- **AI-Powered Research Tools.** AI research assistants can serve as virtual research librarians, aiding students in navigating vast amounts of information effectively. These tools can identify credible sources and extract relevant data for research. AI can sift through search results, giving priority to scholarly articles, respected news sources, and other reliable information sources, unlike simple search engines that may prioritize popular or paid content. Then, they can scan complex texts to pinpoint key data important for a students' research or provide summaries of necessary information. This feature helps students save time and concentrate on analyzing and interpreting data.

For instance, picture a group project where students are studying the primary causes of climate change. An AI research assistant can aid in finding relevant academic journals, extracting data on

greenhouse gas emissions and deforestation, and even recommend documentaries showcasing effective strategies to combat global warming. This enables students to delve deeply into research and gain a comprehensive understanding of the subject.

- **AI-Powered Collaboration Platforms.** Virtual collaboration tools enable students from different locations to work on projects together. AI features in these platforms, like real-time translation, can enhance collaboration. AI translation tools help break down language barriers, allowing students to communicate and exchange ideas effectively. Additionally, AI-powered platforms offer a shared workspace for efficient data organization, assisting students in organizing research materials, brainstorming, and tracking project progress collectively.

Take the previous group project about climate change as an example. Students can use a virtual collaboration platform to connect with students from another country. Together, they can research the impact of global warming in their respective regions, share data and findings, and develop collaborative solutions using AI translation tools to bridge communication gaps if any. This exercise promotes critical thinking, teamwork, and problem-solving on a global scale.

- **AI-Powered Data Analysis and Visualization.** AI-powered data visualization tools can transform complex datasets into clear and engaging visuals. This allows students to:
  - **Identify Patterns and Trends.** Students can manipulate data sets using AI tools and discover hidden patterns, relationships, and trends within the data that might be difficult to identify through manual analysis.
  - **Create Compelling Presentations.** AI visualization tools can generate clear and visually appealing presentations of their research findings, enhancing communication and audience engagement.

Students engaging in the climate change project mentioned above have the opportunity to utilize an AI data visualization tool for examining deforestation data and its correlation with global warming. By using this tool, students can track trends in forest loss over time, identify regions with significant deforestation rates, and assess the possible effects on biodiversity and climate patterns. Additionally, they can leverage the AI tool to craft engaging visuals for sharing their discoveries with classmates. This approach promotes the

development of critical thinking, data analysis skills, and scientific communication abilities.

### *Incorporating AI-Driven Simulations and Scenario-Based Learning*

- **Immersive Learning and Active Problem-Solving.** According to Hyperspace (2024), AI-powered simulations provide a potent method for crafting authentic and dynamic learning settings, enhancing interactive and engaging learning experiences. These simulations surpass conventional rote memorization and passive learning by immersing students in compelling scenarios where they can:
  - **Test hypotheses and solve problems.** Students can experiment with different approaches within the simulation, analyze the consequences of their decisions, and refine their strategies. This active problem-solving fosters critical thinking and decision-making skills in a safe and controlled environment.
  - **Develop adaptability and resilience.** AI-powered simulations can introduce unexpected challenges or consequences within the scenario. This encourages students to think on their feet, adapt their strategies, and learn from virtual mistakes, fostering resilience and the ability to handle unforeseen situations.

Imagine a chemistry class where students use an AI-powered virtual lab to conduct experiments. The simulation allows them to manipulate variables (e.g., temperature, concentration), observe virtual reactions, and analyze the results. This provides a safe and cost-effective alternative to traditional labs, while still allowing students to learn key scientific concepts and practice critical thinking skills.

- **Beyond Simulations.** AI can also enhance traditional scenario-based learning activities. Incorporating AI into traditional scenario-based learning activities empowers educators to create more dynamic and interactive learning experiences for students. AI technology can provide personalized feedback, adapt scenarios based on student responses, fostering critical thinking and problem-solving when students are navigating through complex situations.

Imagine a language class where students are practicing business negotiations. An AI-chatbot can be programmed to play the role of a virtual negotiating partner, adapting its responses and strategies

based on student actions. This creates a more dynamic and realistic role-playing experience, encouraging students to hone their communication and problem-solving skills.

AI can personalize scenario-based learning experiences by providing personalized feedback and tailoring the challenges and situations to individual student needs. For example, an AI-powered social studies simulation might adjust the level of difficulty or introduce specific historical figures or events relevant to a student's learning goals.

In essence, the integration of AI into education represents a transformative paradigm shift, empowering students to become ethical and proficient navigators of the digital landscape. As educators, our role is not only to impart knowledge but to inspire curiosity, foster critical thinking, and cultivate the skills necessary for students to thrive in an increasingly complex and interconnected world. Through collaborative efforts and innovative approaches, we chart a course toward a future where every student is equipped with the tools and mindset to shape a better tomorrow.

## Challenges and Considerations

While AI provides exciting prospects for education, its implementation poses a series of challenges and ethical dilemmas that educators and policymakers need to tackle. Le (2023a) outlines six ethical concerns related to the adoption of AI tools like chatbots in education, covering aspects such as privacy, data security, bias, discrimination, and overreliance on technology. Several studies have delved into these concerns and proposed effective solutions (Cardona et al., 2023; Gaskins, 2022). This section primarily focuses on the obstacles and factors to consider when using AI to enhance students' critical thinking and problem-solving abilities.

### *Overreliance on AI and Reduced Effort*

One of the main obstacles in incorporating AI into education is students excessively depending on AI for tasks such as research or problem-solving. The integration of AI in education needs to be handled

cautiously to enhance critical thinking skills, rather than weaken them. If students rely too much on AI for problem-solving or creating content, it could lead to a passive learning approach, which goes against the goal of nurturing active, critical learners (Darwin et al., 2024). Educators are concerned that an excessive reliance on AI systems could hinder students' ability to learn independently, solve problems innovatively, and think critically (Wogu et al., 2018).

Here are some strategies educators can use to address this challenge and promote critical thinking alongside AI use.

- **Encourage Analysis of AI Outputs**

- **Fact-Checking AI Research Results.** After using an AI research assistant to find sources, have students evaluate the credibility of those sources using established fact-checking techniques. This encourages them to question the information presented and identify potential biases in the AI's search results.
- **Debating AI-Generated Solutions.** Present students with a problem and allow them to use AI to generate potential solutions. Then, have them debate the merits of these solutions, identify potential flaws, and propose alternative approaches. This fosters critical thinking and the ability to evaluate the strengths and weaknesses of AI outputs.

- **Emphasize Independent Research Skills**

- **Curated vs. Open-Ended Research Tasks.** Do not solely rely on AI-powered research tools. Balance them with activities that require students to develop independent research skills. For example, assign projects where students must identify relevant keywords, search for information across a variety of sources (not just AI-suggested ones), and critically evaluate the information they find.
- **Library Skills and Source Evaluation.** Dedicate classroom time to teaching traditional library research skills and source evaluation techniques. This empowers students to navigate information landscapes independently and critically analyze information regardless of its source (AI-generated or human-created).

- **Promote Creativity and Open-Ended Thinking**

- **“What If” Scenarios and Brainstorming.** Pose open-ended questions or “what if” scenarios and encourage students to brainstorm creative solutions without relying on AI prompts.

This fosters divergent thinking and problem-solving skills that go beyond simply accepting AI-generated solutions.

- **Project-Based Learning with Open-Ended Questions.** Design project-based learning activities that require students to define their own research questions, develop their own methodologies, and analyze data to reach their own conclusions. This promotes independent thinking and discourages overreliance on AI for pre-determined solutions.

### *“Black Box” Algorithms and Lack of Transparency*

Another significant challenge in utilizing AI for education is the often opaque nature of many algorithms, also known as the “black box” issue. These algorithms can be intricate and hard to comprehend, making it challenging for students and educators to grasp how they generate results. For instance, consider deep learning, a subset of AI. According to AI expert Samir Rawashdeh, Associate Professor of Electrical and Computer Engineering, the process by which a deep learning system reaches its conclusions, much like human intelligence, remains a mystery, and “it’s a big deal” (Blouin, 2023, Introduction). This lack of transparency may impede students’ ability to assess AI-generated information critically and could lead to a sense of distrust toward AI as an educational tool.

Here are some strategies educators can use to demystify AI algorithms through age-appropriate activities:

- **Understanding the Inner Workings.** Take some time to explore the AI tools you are using with your students. Try to identify patterns in the AI’s outputs. For example, if you are using an AI research assistant, see if you can identify any recurring themes in the sources it suggests. This exploration will help you anticipate how the AI might be working, as well as potential areas for bias.
- **Algorithmic Simulations.** Use simple simulations or activities to illustrate how algorithms work in a way students can understand. For example, create a simple flowchart or decision tree to represent the steps an AI might take when recommending a book or grading a quiz. This helps students develop a basic understanding of algorithmic logic.

- **Transparency Through Activities.** Integrate activities that promote critical thinking alongside AI use. For example, if students use an AI research assistant, have them compare the suggested sources with their own search results using different keywords. This helps them develop information literacy skills and identify potential biases within any information source, AI-generated or not.

### *The Human Touch: Balancing AI with Creativity and Judgment*

AI offers powerful tools for education, but it is crucial to remember that human teachers are irreplaceable (Le, 2023a). Overreliance on AI for tasks like feedback or assessment can stifle the very skills we aim to cultivate, including creativity, critical thinking, and problem-solving (Tobin, 2023). Here's how to strike a balance and ensure the human touch remains central to fostering these essential skills:

- **Prioritizing Tasks for AI that Complement Human Expertise.** Utilize AI for tasks where it excels, freeing you to focus on the irreplaceable human element. For instance, AI can analyze vast amounts of data to identify areas where students might be struggling. Teachers can then use this information to provide personalized, targeted support and guidance that addresses each student's specific needs.
- **AI as a Springboard for Creative Exploration.** Do not view AI as a source of definitive answers. Instead, use it as a springboard for creative exploration. For example, if students use an AI writing assistant, encourage them to consider the suggestions, but also push them to explore alternative phrasing or creative approaches. AI can spark ideas, but human creativity brings them to life.
- **Human Judgment in Feedback and Assessment.** While AI can offer automated feedback on certain aspects of student work, reserve final judgment and assessment tasks for yourself. Use AI-generated data as a starting point, but always consider the context of the student's work, their individual learning journey, and the specific learning objectives of the task. Your nuanced human judgment is essential for providing meaningful feedback that motivates and inspires students.

- **Fostering Social-Emotional Learning.** AI excels at data analysis, but it lacks the ability to nurture social-emotional skills (Le, 2023a). Activities that promote collaboration, empathy, and critical reflection are essential for well-rounded learners. Design projects and discussions that encourage students to grapple with complex issues, debate ideas respectfully, and learn from each other. These are areas where the human touch is irreplaceable.

### *Ensuring Equitable Access to AI-Powered Learning*

The potential of AI-driven education can be maximized only when every student has equitable access to this technology. Akgun and Greenhow (2022) highlighted a crucial issue: the risk that AI systems might exacerbate societal disparities instead of reducing them. It is imperative for education to offer fair opportunities to all for a truly inclusive and just learning environment. Here are some key challenges and strategies to consider:

- **Ensuring Equitable Access to AI-Powered Learning**
  - **The Digital Divide.** Unequal access to technology and the internet can exacerbate existing educational inequalities. Schools and policymakers need to bridge the digital divide by providing all students with access to devices, internet connectivity, and the technical support needed to utilize AI-powered learning tools.
  - **Cost and Sustainability.** The cost of some AI-powered learning platforms can be a barrier for schools with limited resources. Open-source AI tools and government initiatives can help ensure all schools have access to affordable, high-quality AI-powered learning resources.
- **Empowering Educators Through Professional Development**
  - **AI Integration Training.** Provide educators with ongoing professional development opportunities focused on effectively integrating AI tools into their lessons.
  - **Critical Thinking Alongside AI.** Teacher training should emphasize fostering critical thinking skills alongside AI use. Educators should learn strategies to encourage students to question AI outputs, analyze data presented by AI tools, and develop their own independent judgment.

- **Building a Support Network.** Create a professional learning community (PLC) or online forum where educators can share experiences with AI-powered learning tools, troubleshoot challenges, and learn from each other's successes. This fosters collaboration and ensures educators feel supported as they integrate AI into their classrooms (DeFlitch, 2024).

Incorporating AI into lessons to enhance critical thinking and problem-solving shows immense potential, but presents notable challenges. These obstacles involve avoiding excessive dependence on AI, guaranteeing transparency in algorithms, upholding human interaction, and ensuring fair access. Key strategies like simplifying AI, combining AI with human skills, and bridging the digital gap are crucial. By addressing these hurdles, we can optimize the advantages of AI, while upholding the authenticity and accessibility of education.

## Future Directions

AI-powered learning is in its initial phases, yet it carries significant potential for revolutionizing education. As AI technology progresses and becomes more integrated into educational environments, personalized learning experiences tailored to each student's requirements are likely to emerge. This could enhance student engagement, retention, and metacognition. Furthermore, AI systems could support educators by offering valuable feedback on student advancement and areas needing enhancement. Let us take a peek into the future possibilities.

### *Advancing Critical Thinking and Problem-Solving with AI*

- **Metaverse Learning Environments.** Imagine immersive learning experiences within the metaverse, where students can collaborate on complex projects in realistic virtual environments. For example, a team of students studying ancient Rome could be tasked with designing and constructing a virtual public bathhouse within a recreated Roman city. The metaverse environment allows them to research historical architectural styles, collaborate on the design using 3D modeling tools, and grapple with challenges like resource

allocation and structural integrity. This fosters critical thinking by requiring them to analyze historical information, apply problem-solving skills, and collaborate effectively to achieve a common goal.

- **AI-Powered Social-Emotional Learning (SEL).** Currently, only few certain AI-powered chatbots and devices can basically assist students in social-emotional learning (Prothero, 2023). Future advancements could personalize SEL experiences by offering students virtual mentors or AI companions tailored to their needs. For instance, a student struggling with social anxiety might be paired with a virtual peer who can guide them through role-playing social scenarios like giving a presentation or participating in a group discussion. The AI companion could provide feedback on the student's communication skills and offer strategies for managing anxiety in these situations. This creates a safe space for students to develop critical self-awareness, empathy, and conflict resolution skills—essential components of critical thinking and problem-solving in the real world.
- **Metacognitive Development Through AI Coaching.** Metacognition refers to a student's ability to think about their thinking (Chick, 2013). AI tutors could be designed to coach students on metacognitive strategies in a subject-specific way. Imagine an AI tutor analyzing a student's science experiment write-up. Beyond identifying factual errors, the AI might prompt the student to reflect on their thought process by asking: *Did you consider alternative explanations for your results?* or *What additional data would strengthen your conclusions?* This type of metacognitive coaching can help students become more aware of their scientific reasoning, fostering critical thinking and the ability to self-regulate their learning processes.

### *Opportunities for Further Research and Development*

- **Explainable AI (XAI) for Education.** While some AI tools offer a glimpse into their reasoning, many function as complex "black boxes," creating a need for continued research in XAI for education. Imagine AI-powered learning platforms that explain their thought processes in a way students can understand. This transparency can foster trust and critical thinking, and empower students to effectively evaluate AI outputs.

- For example, an AI tutor analyzes a student's essay about the causes of the French Revolution. The essay mentions the rise of Enlightenment ideals, but the AI suggests exploring economic factors in more detail. The XAI feature could explain that the AI scanned the essay for keywords and identified a focus on political causes. It would then explain that historically, economic factors also played a significant role in the revolution, and suggest resources for the student to learn more about this aspect. This allows students to understand why the AI made the suggestion and empowers them to make informed decisions about incorporating this feedback into their writing.
- **Assessing Critical Thinking Skills with AI.** Future AI-powered assessments could analyze a wider range of data points to evaluate critical thinking skills. Imagine a history course where students are presented with a primary source document, a letter written by a soldier during the American Civil War. An AI assessment tool could analyze students' written responses, evaluating factors like the ability to identify the soldier's perspective, analyze the historical context of the document, and support their claims with evidence drawn from the letter and other historical sources. This provides a more nuanced picture of a student's critical thinking abilities and allows educators to tailor instruction to address individual strengths and weaknesses.
- **The Human–AI Partnership in Education.** Although there is a prediction that teachers will be replaced by AI by 2027 (Houser, 2017), the future of education is not about AI replacing teachers, but rather about a powerful partnership. Research should explore how AI can best complement human educators. Le (2023a) indicates a number of tasks that an AI-chatbot can effectively handle for teachers, including lesson planning and administrative tasks like managing attendance, test scoring, and communicating with parents. Imagine AI-powered tools that handle routine tasks like grading multiple-choice quizzes or providing basic feedback on grammar, freeing up teachers to focus on personalized instruction, complex problem-solving activities, and fostering social-emotional learning in students.

However, further research and progress are necessary to explore how AI can support teachers in their teaching methods and professional growth. Human educators contribute their expertise, empathy, and motivational skills, while AI manages time-consuming tasks, leading to a more productive and proficient learning setting.

The future of education is brimming with possibilities as AI continues to evolve. By embracing advancements in XAI, AI-powered assessment, and the human–AI partnership, we can unlock a world of learning experiences that foster critical thinking and problem-solving skills in all students. The journey toward this future requires ongoing research, collaboration between educators and AI developers, and a commitment to ensuring equitable access to these powerful tools.

## Conclusion

*“Education is not the learning of facts, but the training of the mind to think.”*—Albert Einstein

In closing, let us rally around the transformative power of AI to reimagine education, emboldening our students to transcend the confines of rote memorization and emerge as dynamic thinkers and adept problem solvers in a world that constantly demands innovation. Albert Einstein’s timeless wisdom resonates profoundly: “Education is not the learning of facts, but the training of the mind to think.” This underscores the profound shift we aspire to enact through the seamless integration of AI into the educational landscape.

With AI as our ally, we embark on a voyage of discovery, igniting the spark of curiosity, stoking the fires of creativity, and nurturing the spirit of critical inquiry within each student. No longer confined to the passive absorption of information, our learners become active participants in their own intellectual journeys, charting courses of exploration and discovery guided by the gentle hand of AI-enabled mentorship.

In this journey, AI serves not as a mere tool, but as a catalyst for intellectual liberation, unlocking the potential of every mind to soar to unprecedented heights. As the boundaries of possibility expand, so too do the horizons of our imagination, beckoning us to venture boldly into uncharted territories of knowledge and understanding. With this ethos guiding our path, let us delve deeper into the key points that underscore the profound impact of AI on education, particularly on fostering critical thinking and problem-solving skills among students.

- **AI as a Catalyst for Critical Thinking and Problem-Solving.** In embracing AI, we recognize its transformative potential to cultivate

critical thinking and problem-solving skills for students. These skills, vital for navigating the complexities of the modern world, are not simply academic pursuits, but the very essence of intellectual empowerment.

- **Practical Strategies for Empowerment.** Our journey is illuminated by practical strategies that leverage AI to empower learners. From instilling ethical AI usage to fostering self-assessment and incorporating AI-driven simulations and project-based teaching and learning, each strategy serves as a stepping stone toward a future where students are active agents in their own learning and cognitive processes.
- **Challenges and Opportunities.** Alongside the promise of AI, we confront challenges, such as the risk of overreliance and the imperative of maintaining transparency and ethical integrity. Yet, within these challenges lie opportunities for growth and innovation, as we navigate the delicate balance between technological advancement and human ingenuity.

Guided by these insights, we are compelled to action, recognizing the imperative of collective effort in realizing the transformative potential of AI in education. Thus, we extend an invitation to educators, policymakers, technologists, and stakeholders alike to join hands in the pursuit of the following initiatives:

- **Ethical Guidelines and Frameworks.** Together, let us forge comprehensive guidelines and frameworks to govern the ethical use of AI in education. With clear principles and standards, we ensure that the integration of AI remains rooted in integrity and respect for human dignity.
- **Advocacy for Transparency and Accountability.** Advocacy for transparency and accountability in AI algorithms is paramount, to foster a culture of trust and reliability, safeguarding against the pitfalls of algorithmic opacity.
- **Cultivating Creativity and Innovation.** Our journey toward educational transformation must be marked by a steadfast commitment to cultivating creativity and innovation. By embracing the symbiotic relationship between human creativity and technological advancement, we create a fertile ground for the flourishing of new ideas and possibilities.

- **Ensuring Equitable Access.** The promise of AI in education must be accessible to all, regardless of background or circumstance. Let us work tirelessly to bridge the digital divide, ensuring equitable access to AI-powered educational resources for every learner.

## Discussion Questions

1. How can we adeptly balance the integration of AI tools with traditional pedagogical methodologies to maximize learning outcomes and foster holistic development?
2. What measures can be taken to address concerns surrounding algorithmic bias and ensure that AI-powered educational resources are inclusive, culturally sensitive, and accessible to diverse learners?
3. In what ways can we empower students to critically evaluate and challenge the recommendations and insights provided by AI systems, nurturing a culture of informed skepticism and intellectual curiosity?
4. As we continue to advance AI technologies, how might future developments further augment student critical thinking and problem-solving capabilities, and what are the implications for educational practice and policy?
5. How can educators navigate the ethical considerations inherent in the integration of AI into educational settings, particularly in fostering critical thinking, problem-solving, and other essential life skills among students?

In grappling with these questions, let us foster a spirit of inquiry, collaboration, and innovation, emboldened by the belief that through concerted effort and unwavering commitment, we can harness the full potential of AI to reshape the landscape of education for generations to come. May we approach this challenge with open minds and a shared vision of creating a brighter future for learners of all ages and backgrounds. Let us embrace the possibilities that AI offers, while also being mindful of the ethical considerations and potential pitfalls that come with its implementation. Together, let us strive to unlock the transformative power of AI in education, paving the way for a more inclusive, engaging, and personalized learning experience for all.

## References

Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *AI Ethics*, 2(3): 431–440.

Ali, S. (2024). Natural language processing in automated feedback for eLearning. *eLearning Industry*. <https://elearningindustry.com/natural-language-processing-in-automated-feedback-for-elearning>

Andrus, D. (2023). The power of reflection and self-assessment in student learning. *Education World*. [www.educationworld.com/teachers/power-reflection-and-self-assessment-student-learning](http://www.educationworld.com/teachers/power-reflection-and-self-assessment-student-learning)

Blouin, L. (2023). AI's mysterious "black box" problem, explained. *UM-Dearborn*. <https://umdearborn.edu/news/ais-mysterious-black-box-problem-explained>

Cardona, M. A., Rodríguez, R., & Ishmael, K. (2023). *Artificial intelligence and the future of teaching and learning: Insights and recommendations*. US Department of Education, Office of Educational Technology.

Carucci, R. (2024). In the age of AI, critical thinking is more needed than ever. *Forbes*. [www.forbes.com/sites/roncarucci/2024/02/06/in-the-age-of-ai-critical-thinking-is-more-needed-than-ever](http://www.forbes.com/sites/roncarucci/2024/02/06/in-the-age-of-ai-critical-thinking-is-more-needed-than-ever)

Chick, N. (2013). *Metacognition*. Vanderbilt University Center for Teaching. <https://cft.vanderbilt.edu/guides-sub-pages/metacognition/>

Darwin, Rusdin, D., Mukminatien, N., Suryati, N., Laksmi, E. D., & Marzuki. (2024). Critical thinking in the AI era: An exploration of EFL students' perceptions, benefits, and limitations. *Cogent Education*, 11(1). <https://doi.org/10.1080/2331186X.2023.2290342>

DeFlitch, S. (2024). AI in schools: A strategic approach for district-wide implementation. *Panorama Education*. [www.panoramaed.com/blog/ai-in-schools](http://www.panoramaed.com/blog/ai-in-schools)

Dweck, S. (2016). *Mindset: The new psychology of success*. Ballantine Books.

Ennis, R. H. (2015). Critical thinking: A streamlined conception. In M. Davies & R. Barnett (Eds.), *The Palgrave handbook of critical thinking in higher education* (pp. 31–47). Palgrave Macmillan. <https://doi.org/10.1057/9781137378057>

Gaskins, N. (2022). Interrogating algorithmic bias: From speculative fiction to liberatory design. *Techtrends*, 3(67), 417–425. <https://doi.org/10.1007/s11528-022-00783-0>

Houser, K. (2017). The solution to our education crisis might be AI. *Futurism*. <https://futurism.com/ai-teachers-education-crisis>.

Hwang, G. J., Lai, C. L., Liang, J. C., Chu, H. C., & Tsai, C. C. (2018). A long-term experiment to investigate the relationships between high school

students' perceptions of mobile learning and peer interaction and higher-order thinking tendencies. *Educational Technology Research and Development*, 66(1), 75–93. <https://doi.org/10.1007/s11423-017-9540-3>

Hyperspace. (2024). *Personalized project-based learning with AI*. <https://hyperspace.mv/project-based-learning-ai/>

Jovanović, A., & Milosavljević, A. (2022). VoRtex metaverse platform for gamified collaborative learning. *Electronics*, 11, 317. <https://doi.org/10.3390/electronics11030317>.

Le, D. B. Q. (2023a). *The art and science of ChatGPT in education*. Ukiyoto Publishing

Le, D. B. Q. (2023b). Empowering learning: 5E lesson plan for the IBL experience. *EduVerse Newsletter*, 3, 8–13. [www.proed.com.vn/\\_files/ugd/4f4dcf\\_b2a3ae5316564c10b31e32dd45e7299e.pdf](http://www.proed.com.vn/_files/ugd/4f4dcf_b2a3ae5316564c10b31e32dd45e7299e.pdf)

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. Pearson Education.

Martinez, M. E. (1998). What is problem solving? *The Phi Delta Kappan*, 79(8), 605–609. [www.jstor.org/stable/20439287](https://www.jstor.org/stable/20439287)

Meehirr, K. (2023). How AI is personalizing education for every student. *eLearning Industry*. <https://elearningindustry.com/how-ai-is-personalizing-education-for-every-student>

OECD. (2005). *PISA 2003 technical report*. <https://doi.org/10.1787/9789264010543-en>

Pangambam, S. (2023). A well educated mind vs a well formed mind: Striking a balance in education—An essay. *The Singju Post*. <https://singjupost.com/a-well-educated-mind-vs-a-well-formed-mind-striking-a-balance-in-education-an-essay>

Partnership for 21st Century Learning. (2009). *P21 framework definitions*. <https://files.eric.ed.gov/fulltext/ED519462.pdf>

Paul, W. R., Elder, L., & Bartell, T. (1997). *California teacher preparation for instruction in critical thinking: Research findings and policy recommendations*. Foundation for Critical Thinking.

Prothero, A. (2023). Artificial intelligence and social-emotional learning are on a collision course. *Education Week*. [www.edweek.org/leadership/artificial-intelligence-and-social-emotional-learning-are-on-a-collision-course/2023/11](http://www.edweek.org/leadership/artificial-intelligence-and-social-emotional-learning-are-on-a-collision-course/2023/11)

Teixeira, N. (2023). Empowering students: How generative artificial intelligence transforms research skills in education. CYQIQ. [www.cyqiq.ai/blog/empowering-students-how-generative-artificial-intelligence-transforms-research-skills-in-education](http://www.cyqiq.ai/blog/empowering-students-how-generative-artificial-intelligence-transforms-research-skills-in-education)

Tobin, J. (2023). *Educational technology: Digital innovation and AI in schools*. House of Lords Library (UK Parliament). <https://lordslibrary.parliament.uk/educational-technology-digital-innovation-and-ai-in-schools>

Trigyn Technologies. (2023). *11 ways artificial intelligence is transforming digital learning*. [www.trigyn.com/insights/11-ways-artificial-intelligence-transforming-digital-learning](http://www.trigyn.com/insights/11-ways-artificial-intelligence-transforming-digital-learning)

Wogu, I. A. P., Misra, S., Olu-Owolabi, E. F., Assibong, P. A., Udo, O. D., Ogiri, S. O., & Damasevicius, R. (2018). Artificial intelligence, artificial teachers and the fate of learners in the 21st century education sector: Implications for theory and practice. *International Journal of Pure and Applied Mathematics*, 119(16), 2245–2259.



**Taylor & Francis**  
Taylor & Francis Group  
<http://taylorandfrancis.com>

# Part III

## Ethical and Institutional Considerations



**Taylor & Francis**  
Taylor & Francis Group  
<http://taylorandfrancis.com>

# Rethinking Cheating in the Age of AI

6

Clive Forrester

## Introduction

The earliest use of artificial intelligence dates to the 1950s when Alan Turing published his seminal paper asking whether it was possible for machines to think (Turing, 1950). Shortly afterwards in 1952, Arthur Samuels developed a computer game that could independently learn checkers (Computer History Museum, 2019) and in 1955 Princeton mathematician John McCarthy held a workshop at Dartmouth where the term *artificial intelligence* made its public debut. In the 70 years since that time artificial intelligence has advanced in leaps in bounds and has impacted every aspect of modern life ranging from entertainment to manufacturing, healthcare, politics, education, sports, dating, and beyond. When people talk about the *age of AI*, however, they are referring to the dawn and proliferation of large language models, or LLMs, that can be traced to the public announcement of OpenAI's ChatGPT in November of 2022.

By January the following year, ChatGPT had achieved a milestone of 100 million monthly users, with a daily influx of 13 million new users. This represented a twofold increase from the previous month (Marche, 2022). With such a meteoric rise, this open-source tool has proven to be the fastest growing internet-based consumer app, eclipsing social media powerhouses such as TikTok and Instagram which took nine months and two years respectively to get to the 100 million user mark (Hu, 2023). One of the biggest drawing points for ChatGPT was its ability

to synthesize large amounts of information. Unlike search engines and AI assistants, such as Siri and Alexa, ChatGPT could pull information from its vast database and create novel answers to a wide variety of questions on almost any topic. It could also present the information in a natural conversational style, or format it in a more scholarly fashion based on the preference of the end user. Indeed, in the first quarter of 2023, ChatGPT showed that it can successfully pass a college level microbiology test (Berezow, 2022), the United States Medical Licensing Exam (USMLE) (Kung et al., 2023), as well as a series of law exams from the Minnesota Law School (Choi et al., 2023), among others. These milestones were achieved by ChatGPT 3.5. As of Spring 2024, the software has advanced to version 4.0. By the time this chapter is published the software's capabilities may have further evolved, especially with ChatGPT-5 set to be released in late 2024 or early 2025.

Large language models like ChatGPT, and more recently Google Gemini, Anthropic's Claude, and Microsoft's Co-Pilot, are particularly attractive to researchers and students alike because they are able to do the one thing that, until 2022, seemed like science fiction—information synthesis. The databases used to train these tools are so extensive, and the computational power so impressive, that essay length answers on any academic topic can be generated in mere seconds. Sometimes responses are not entirely accurate, and proper citation of sources still needs improvement, but for the average undergraduate student rushing to complete an overnight-essay, AI is a godsend. Undoubtedly, AI software based on machine learning represents a novel and powerful tool for researchers tasked with analyzing and focused conclusions generated. However, it also opens up new avenues for academic misconduct, creating a potential *cheaters' paradise* in this era of advanced AI tools.

### Cheaters 1, Universities 0

In December 2022, The Atlantic ran an article titled “The College Essay Is Dead: Nobody Is Prepared for How AI Will Transform Academia” (Marche, 2022). The image accompanying the article depicted several college essays arranged in the shape of a skull, serving as a harbinger

of doom. This ominous image preceded the explosion of AI use the following month at the start of the January term. The article quotes Professor Mike Sharples from the UK who urged educators to rethink teaching and assessment in response to the advent of this technology (Marche, 2022). By the start of the 2023 winter term, ChatGPT was already experiencing over-capacity user activity, resulting in wait times of several hours to use the service. The secret was out and students in college classrooms all over the world were clamoring to create accounts and familiarize themselves with the chatbot; a new era in AI-assisted college level writing had begun.

Henderson (2015) addresses the common perception about academic writing very early in the third edition of the popular textbook *The Active Reader* when he says, “For some people, academic writing is a euphemism for dense, abstract writing, so highly specialized as to be virtually impenetrable to non-specialists” (p. 3). This is likely how many students view academic writing as new initiates, with the added caveat that it is just as difficult to produce as it is to decipher. Nevertheless, all new undergraduates (and even some graduate students) are expected to enroll in, and pass, at least one course specifically designed to baptize students into university style reading, thinking, and writing. Depending on the program of study, additional writing courses that deal with discipline specific communication may also be required, as witnessed by the expanded adoption of writing across the curriculum on college and university campuses (Purdue Writing Lab, n.d.). Essentially, though some students might find their apprenticeship as academic writers unnecessary drudgery, there is no escaping this technical form of communication for three main reasons. The first is that employers in the corporate world cite communicative proficiency as among the most desirable traits of new employees. Second, colleges and universities have devised elaborate macro level communication objectives that all students are expected to meet as a condition of their graduation. Third, at the level of individual courses, the traditional college style essay still forms the main source of assessment particularly in the humanities and social sciences (which makes up the bulk of students in most major universities). It is this third reason that has the most significant implications for the use of AI tools; assessment is still largely dependent on the long form composition, and AI software like ChatGPT can write essays, on almost any topic, in seconds.

Cheating in academic writing typically happens in one of two ways. The first is when a student writer commits the cardinal sin of plagiarism. This could be unintentional, such as when students believe that a more experienced writer can better explain a topic leading them to copy and paste large chunks of the original work. In such instances, students may include citations for good measure, but the extent of unoriginal content is too great for the work to be considered their own. In these instances, the essay might even be in violation of copyright laws. Intentional plagiarism is even more egregious. Here, students employ wholesale copy-pasting, but this time, they attempt to pass it off as their own work. No, or few, citations are presented, and the reference page—if one is included—may be scant or populated with mostly non-academic sources. This is the traditional *lazy* version of plagiarism that is tantamount to intellectual theft. If caught, the penalty ranges from a grade of zero at the lighter end, all the way up to a disciplinary hearing and possible expulsion in more severe cases.

A second way of cheating in academic writing is to simply outsource the essay writing process. This too is a form of plagiarism but tends to require a little more effort, especially in cases where money is involved. A student can purchase an essay from an essay bank or pay a writer to produce the assignment. Generally, the end product tends to be far more polished—formatting is crisp, the discussion and analysis are cogent, and the essay is well-researched as evidenced by the in-text citations. Essay mills (Campbell, 2023) and assignment repositories are so common that they are advertised as legitimate businesses online and sometimes even on campus notice boards.

Both methods of cheating—intellectual theft, or the black market—can easily be caught by plagiarism detection software such as Turnitin. Just as how professors recycle their essay questions from year to year, the same happens with essay banks and ghost writers. Since most of these essays are handed in digitally, it is fairly simple to check them against existing published works or against other essays that have been run through plagiarism detection software. However, a savvy user of AI tools is able to circumvent this detection.

Chatbots like ChatGPT create original pieces of writing. As such, it is possible to generate an essay that is indistinguishable from one created by a hard-working student of above average writing skills. The output might be somewhat dry and lifeless when read, but so is

much of undergraduate writing (undergrads are, after all, mimicking what their professors do). Regardless, in several instances, the output may be deemed sufficient to receive passing grades in various subject areas after being reviewed by human evaluators. In many instances plagiarism detection tools may not be able to identify the output as computer generated. A careful student who intends to cheat would simply have to make cosmetic adjustments to AI generated output and it would safely pass just about any plagiarism detection.<sup>1</sup>

## Rethinking the Landscape of Academic Integrity

One of the most pressing challenges lies in adapting academic integrity policies to address the ethical usage of AI tools. Universities were caught on the defensive at the start of the 2023 term, and hurriedly worked to revamp their academic integrity policies before too much time had passed. Most of the existing policies were thought to be ironclad, so it was hard to imagine that loopholes existed. However, consider what a New Zealand student confessed about their use of ChatGPT to a student newspaper (Heyward, 2023):

I have the knowledge, I have the lived experience, I'm a good student, I go to all the tutorials and I go to all the lectures and I read everything we have to read but I kind of felt I was being penalized because I don't write eloquently and I didn't feel that was right.

I looked through the [UC] rules and it says you can't get somebody else to [do the assessment]. Well it's not somebody, it's AI. (para. 9–13)

This response exemplifies a classic case of ignoring the *spirit* of the law in favor of the letter of the law. It does however raise questions about what level of assistive writing is permissible in student assignments. Outsourcing the entirety of the essay is obviously excessive. But what about using an AI tool to get over writers' block? Most spellcheck software nowadays also includes features that allow you to rephrase entire sections for clarity, formality, and the like—should these be allowed as well?

Current policies primarily focus on defining and detecting plagiarism as the direct copying of existing text (Adams Becker et al., 2018). This definition becomes insufficient when AI can produce original, human-quality content indistinguishable from student work. Outright prohibiting AI tools altogether is impractical. AI-powered grammar checkers, for instance, enhance the quality of student writing without directly producing the content itself. Furthermore, some AI tools can be valuable pedagogical resources, providing personalized feedback and adaptive learning environments.

Therefore, academic integrity policies need to evolve to encompass the ethical use of AI tools. This necessitates a shift from a purely prohibitive approach toward a framework that fosters responsible AI use in academic work. Such a framework could include:

1. **Transparency in AI Utilization.** Universities should encourage students to disclose their use of AI tools within assignments, allowing instructors to assess the learning process and students' critical engagement with the material.
2. **Redefining Plagiarism in the AI Era.** Academic integrity policies need to explicitly define plagiarism in the context of AI-generated content. This could involve considering the extent of human intervention in the AI-generated work and the originality of the ideas presented.
3. **Focus on Learning Outcomes.** The emphasis in academic integrity should shift toward assessing students' understanding and ability to critically analyze information, rather than solely focusing on the originality of written work.
4. **Promoting Digital Literacy.** Universities can equip students with the skills to critically evaluate information generated by AI and distinguish between legitimate use of AI tools and plagiarism.

Academic integrity policies should also acknowledge the possibility that some forms of academic work might require the use of assistive AI tools. For instance, AI tools can be used to analyze vast datasets, generating insights that would be time-consuming or impossible for students to achieve independently. Calculators, digital spreadsheet software, and statistical analysis programs have unlocked vast computational power and allowed students and researchers alike to extract volumes of information from dense numerical data. Generative AI

tools can do the same for large portions of textual data and more. The paid version of ChatGPT, for instance, can analyze, summarize, and extract key points from YouTube videos simply from including the hyperlink in the prompt. This is a level of computer-assisted information synthesis that researchers have never had access to before, and it would be a shame not to harness this capability for academic research. However, this shift requires clear guidelines regarding the acceptable use of AI in such scenarios.

### *The Rising Propensity to Cheat*

During the 2023–24 academic year, there was a notable increase in the number of students submitting assignments created with AI tools. A cursory glance at social media sites and online forums frequented by college instructors revealed significant frustration among faculty, who felt their responsibilities had increasingly devolved into policing AI-generated submissions as the term neared its conclusion. In response to this escalating arms race, Turnitin, the most widely utilized plagiarism detection software in colleges and universities, enhanced its program to also detect AI-generated text.<sup>2</sup> Concerns about cheating and plagiarism have reached unprecedented levels as administrators and professors strive to keep pace with the rapid developments in AI. Despite their efforts, many of them find themselves ensnared in a perpetual cycle of catch-up.

Attempting to outpace cheaters in the age of AI is a futile endeavor. Investigating suspicions of AI-generated plagiarism is an exceedingly time-consuming burden, even when dealing with a single case, let alone multiple instances. The instructor must collect compelling evidence, file a report, respond to challenges from the student when that inevitably comes, and possibly attend a disciplinary hearing that *may* find the student guilty, all while the professor is engaged in other duties involving teaching, research, and service. The other issue has to do with the evolving nature of AI itself. Within months of ChatGPT becoming mainstream, several new AI tools emerged, capable of transforming AI-generated text into more natural-sounding human speech. Essentially, a student who knows about these tools could set up a workflow which goes like this: create a prompt to answer the

essay question for a course, run the prompt through ChatGPT and generate an answer, take that answer and run it through an AI software like Quillbot to rephrase it so it sounds more natural, then hand in the final product. With about an hour's worth of work, the end product could fool plagiarism detection software into thinking it was written by a human.

Also, institutions seldom address the underlying motivations that drive students to cheat. Consider this insightful perspective shared by a top performing student from an elite high school in the US:

People don't go to school to learn. They go to get good grades which brings them to college, which brings the high paying jobs, which brings them to happiness, so they think. But basically, grades is where it's at. (Pope, 2001, p. 4)

The sentiments expressed by this student certainly resemble my own experience, first as an undergraduate and now as a professor of undergraduate students. The average full time undergraduate student enrolls in five courses per 12-week term. Beyond academic demands, students' time is further strained by extracurricular activities, community involvement, and employment, leading to a substantial portion of their lives being dedicated to managing assignments and seeking extensions. The pervasive hustle to earn an A is supplanting the quest for knowledge as the primary reason for attending university, and it should come as no surprise that some students will sometimes bend the ethical guidelines in furtherance of this pursuit. With the cost for tuition getting prohibitively expensive in many universities, the stakes of failure are so high that cheating becomes a necessary consideration. This issue is exacerbated by the over-reliance on assessment types that can be easily outsourced to AI tools.

### *AI Tools and the College Essay*

While the prospect of AI-powered cheating may conjure images of students effortlessly churning out perfect essays, the ease of using these tools hinges heavily on the type of assessment itself. Traditional long-form essays, a mainstay in higher education, especially in the

humanities and social sciences, present a vulnerability in this digital age. Here's why:

1. **Structure and Predictability.** Essays often follow a predictable structure: introduction, body paragraphs with supporting evidence, and a conclusion. AI thrives on patterns, and this formulaic approach plays right into its strengths. Students can easily identify essay prompts that align with readily available AI templates or prompt specific content generation based on existing knowledge in the machine's database.
2. **Limited Assessment of Critical Thinking.** Essays often emphasize factual recall and regurgitation of information, precisely the tasks AI excels at. A well-trained LLM can synthesize vast amounts of data, generate relevant quotes and statistics, and even mimic different writing styles. This ability poses a challenge in discerning between a student's genuine understanding and AI-generated content, particularly for essays heavy on summarizing existing research.
3. **Subjectivity in Evaluation.** Grading essays often involves a degree of subjectivity. While rubrics and clear criteria exist, aspects like style, flow, and critical analysis can be open to interpretation. AI-generated essays can be crafted to mimic a specific writing style and even incorporate transitions, making them appear more cohesive on the surface. This subjectivity creates an additional hurdle for instructors in detecting AI-powered plagiarism.
4. **Limited Focus on Higher-Order Thinking Skills.** Traditional essays often struggle to assess the more nuanced skills crucial for academic success. Critical thinking, independent analysis, and creative problem-solving are essential for navigating the complexities of real-world challenges. However, evaluating these skills effectively requires assessment methods that go beyond regurgitating facts and following a formula. Here's where AI becomes less effective.
5. **The Allure of Anonymity.** Long-form essays often lack the element of real-time engagement or active participation. This anonymity can be attractive for students tempted to utilize AI tools. Unlike an oral presentation where a student's understanding (or lack thereof) is readily apparent, essays offer a layer of separation that allows students to potentially mask their true grasp of the subject matter with AI-generated content.

If all this were not bad enough, the process of marking essays can often prove to be an extremely stressful endeavor for instructors. For writing intensive courses (virtually all disciplines in the humanities) the daunting task of marking the essays at the end of the course looms large and instructors are usually grinding all the way to the last possible minute before grade submissions are due. Even with the time-saving that essay rubrics provide it is still labor-intensive work and there is no way to guarantee that the first set of essays in the batch will be marked with the same level of attention as the last set. It is disappointing to think that with the burden of marking at the end of the term that instructors face, some students might simply be handing in essays wholly generated with AI software.

Notwithstanding any of what has been said above, the essay is still a useful tool. It is still one of the most efficient ways to assess a core set of skills that are necessary at the university level, such as research, use of grammar, rhetorical presentation, and critical thinking. However, there is no reason why the essay has to be the primary, and often sole, tool to assess any of these skills, let alone all of them together. Clear and effective communication is certainly a desirable learning outcome that instructors hope their students will bring into their careers outside the academy, but there are very few careers, especially today, that pattern any communication that is analogous to the college essay. There has to be a better way.

## Rethinking Assessments: Moving Beyond the Essay

While the essay remains a valuable tool for assessing research, critical thinking, and communication skills, its limitations become increasingly apparent in the age of AI. The sheer volume of essays in writing-intensive courses can make them a burden for instructors and students alike. The potential for AI-powered plagiarism further complicates the traditional essay's effectiveness.

However, lamenting the decline of the essay is not enough. The answer lies not in clinging to outdated methods, but in embracing a more diverse and robust approach to assessment. The next section will delve into a range of alternative assessment methods that can enhance learning outcomes, promote active engagement, and cultivate skills

that translate seamlessly into the professional world. Moving beyond the singular focus on the essay allows educators to create a more dynamic and AI-resistant learning environment. Instructors should explore a variety of assessment tools that can empower students to showcase their knowledge, critical thinking, and problem-solving abilities in creative ways.

### *Revamping Courses to Meet the Challenge*

For the instructor who has decided to review assessment types in light of AI software, the first place to start is with the course syllabus. Rather than merely making cosmetic changes to the assignments, it might be useful to revisit the entire structure of the course to determine what kinds of adjustments are needed (if any) to thrive in the era of AI. This might involve looking at the course description, learning outcomes, topics, and the course policies.

The course description serves as a first impression and a roadmap for student expectations. In the age of AI, this description can be revamped to explicitly acknowledge the evolving assessment landscape and emphasize the development of critical thinking skills that AI cannot replicate. For example, instead of simply stating that the course surveys key concepts in X field, the description could be revised to highlight the use of case studies, simulations, and debates to foster critical analysis and problem-solving skills. This transparency sets clear expectations for students and emphasizes the skills that will be prioritized throughout the course. Furthermore, the description can be reframed to showcase how the course leverages technology to enhance learning. This could involve mentioning the use of collaborative online platforms or AI-powered feedback tools to promote active learning and personalized instruction.

Learning outcomes traditionally focus on the knowledge students should acquire by the end of the course. While this remains important, AI's ability to access and process vast amounts of information requires a shift toward outcomes that emphasize deeper learning. Incorporating language that highlights critical thinking, analysis, and synthesis of information strengthens learning outcomes. For instance, instead of simply stating that students will gain knowledge of X theory, the

outcome could be revised to focus on students' ability to critically evaluate X theory and its applications in real-world scenarios.

Similarly, outcomes can be reframed to emphasize communication and collaboration skills. This could include outcomes that assess students' ability to present complex ideas effectively in both written and oral formats or collaborate with peers to solve problems and develop innovative solutions. These refined outcomes move beyond the regurgitation of facts and encourage students to engage with the material in a more meaningful way.

The selection and presentation of course topics can also be adapted to leverage AI and promote deeper learning. Incorporating case studies, simulations, and debates into the curriculum encourages critical thinking and creative problem-solving. These activities require students to analyze complex situations, identify biases, and formulate well-supported arguments—skills that are difficult for AI to replicate.

Additionally, instructors can leverage AI tools to curate personalized learning experiences for students. For instance, AI-powered platforms can recommend additional resources based on individual student needs and interests, fostering a more self-directed and engaging learning environment.

Course policies related to academic integrity also require careful consideration in the age of AI. Outright banning AI tools may not be practical, and a more nuanced approach is necessary. Policies can be revised to encourage transparency by explicitly outlining acceptable uses of AI tools in assignment. For example, instructors can allow students to utilize AI-powered grammar checkers or citation generators but emphasize the importance of critical review and student understanding of the content. Policies can also be structured to reward students for demonstrating their learning process, such as requiring annotated bibliographies or drafts with revision history.

By critically re-evaluating the course syllabus in light of AI's capabilities, instructors can create a more engaging and effective learning environment. Focusing on transparent communication, active learning strategies, and fostering critical thinking skills allows educators to move beyond the limitations of traditional essay-based assessments. This shift toward a more diverse and AI-resistant approach to assessment empowers students to thrive in an era of technological transformation.

### *Alternative Assessments to the Essay*

As stated earlier, the college essay is still an efficient way of assessing a core set of skills, especially the aptitude of a student to deliver clear and cogent written communication. In a typical undergraduate course with 25 students, assigning several papers throughout the course is usually the primary means of cumulative and summative assessment. This, however, is a very restrictive paradigm. When instructors plan a course, they typically identify four or more learning outcomes. While these outcomes are SMART (specific, measurable, achievable, relevant, and time bound) (Doran, 1981, p. 35) and encompass a broad range of course concepts, it is worth questioning whether they must all be assessed through the singular medium of the essay.

A good way to tackle this question is to think back to the mid to late 1990s when personal computers were becoming a household fixture. Assignments could finally be typed, edited, printed, and submitted in a clean, standardized format. Furthermore, the content of these assignments could be enhanced by the computational possibilities in the Microsoft suite of programs (e.g. the possibility to generate spreadsheets with built-in mathematical functions). Instructors had to expand the ways in which they conceptualized a completed assignment considering this new development. The personal computer marked the first major technological phase in rethinking assessment. The internet was the second phase. Instructors had to stretch their imaginations even further and redesign assessments that would take advantage of this new research powerhouse. Generative artificial intelligence is the third and current phase, and instructors must yet again rise to the challenge. In their discussion on rethinking assessments in the digital age, Timmis et al. (2016, p. 455) posed three guiding questions:

1. What do digital technologies offer for educational assessment?
2. How might assessment be different when knowledge and performance can be represented digitally?
3. Where is the cutting edge in such developments presently?

However, these questions, posed seven years before the emergence of generative AI, reflect the technological advances in technology-enhanced assessment of that era. Utilizing these questions as a point

of discussion can yield valuable insights, encourage new forms of knowledge, foster deeper collaboration, and increase flexibility in assessments. As a result of the emergence of generative AI, I propose a slight modification to the original three guiding questions:

1. What does generative AI software offer for educational assessment?
2. How might assessment be different when knowledge and performance can be replicated by generative AI?
3. Where is the cutting edge in such developments presently?

With these modifications in mind, the following alternative assessments to the traditional long form composition are proposed along with an explanation of how generative AI could be incorporated into these assignment types. I have incorporated some of these approaches into my own courses. The design of specific assignments will be shared as illustrative examples. While these alternatives may not be particularly unique, and some instructors might already be using some of them, the recommendations here are intended to divest some of the heavy lifting carried by the essay into more dynamic and creative forms of assessment.

## Portfolios

Curating a collection of student work over the duration of a term offers a more holistic picture of learning progress. Portfolios can include drafts, revisions, reflections, final products, and self-evaluations. They can be used to assess the development of critical thinking skills, research, and communication skills, as well as the capacity to learn from mistakes. AI currently lacks the ability to demonstrate the same level of self-reflection and growth that students can showcase through portfolios. Compiling a portfolio is particularly well-suited for courses with visually detailed assignments, yet other courses can also benefit from this approach.

AI can be a valuable tool in enriching this process. For instance, imagine a history course where students curate a portfolio of their work. An AI tool could be used to analyze existing artwork styles and generate prompts based on specific historical periods or artistic movements. Essentially, an AI tool could be used to reverse-engineer a prompt for a popular piece of artwork like van Gogh's *Starry Night*.

Students could then utilize these prompts to create original artwork, and reflectively discuss the differences between the original piece of artwork and theirs, demonstrating their understanding of the style and incorporating it into their portfolios. This leverages AI's ability to analyze vast amounts of data but requires students to translate that analysis into creative expression.

## Simulations and Roleplays

Interactive scenarios create opportunities for students to apply their knowledge in dynamic situations. Engaging with ethical dilemmas, historical re-enactments, or simulated business negotiations promotes critical thinking, problem-solving, decision-making, and communication skills. These skills are difficult for AI to emulate, as they require adaptation, improvisation, and the ability to respond to unforeseen circumstances. However, AI can actually be co-opted to facilitate this kind of work.

One of the unavoidable things that writing instructors must confront from time to time is how to navigate difficult topics. Topics that are difficult not because of their technical complexity, but because they have the potential to be triggering, offensive, or harmful to class members. Some instructors might feel ill-equipped to handle certain kinds of topics and choose against raising them or not dealing with them if they are introduced by a student. Avoiding this kind of discomfort is understandable, especially if the instructor does not think it is integral to the lesson. However, most students may only ever have the opportunity to discuss difficult topics in the context of a writing classroom, and it would be a disservice to them if the instructor decided no further discussion was warranted. There is a possibility to use ChatGPT in a manner that might make handling these difficult topics easier through simulation.

It is possible for students to “test out” this difficult conversation and simulate their answers with an AI tool like ChatGPT or Google Gemini rather than with their peers. This simulated interaction is a form of self-directed study and could be analyzed afterwards as a peer activity, then incorporated into a portfolio assignment as part of a knowledge synthesis exercise. Below, in Figure 6.1, is a snippet of a simulated debate I had with ChatGPT.

## Space Debate Challenge

Clive forrester • July 25, 2023

---

 **Anonymous**

I challenge you to a debate. You choose the topic and what side you will take. Here are the parameters:

1. We will each take turns arguing our point, while trying to counter the points of the other
2. Responses will be short and to the point
3. We will acknowledge when either of us has either put forward a good point or is unable to think of a better counterpoint.

Are these parameters satisfactory?

 **ChatGPT**

Absolutely, the parameters are satisfactory. I accept your challenge! Let's engage in a debate.

Topic: The advantages and disadvantages of space exploration

I'll take the stance that space exploration has more advantages than disadvantages. You can argue the opposite. Please begin, and we'll proceed with short and concise responses.

 **Anonymous**

Space exploration is a waste of time, effort, and money. We are yet to fully explore the boundaries of our own planet, especially the depths of the ocean, so why should we spend inordinate amounts of money to barely escape the gravitational pull of the earth? Our time is better spent investigating our own planet and trying to solve the myriad problems that we face globally.

 **ChatGPT**

While it's true that we have much to learn about our own planet, space exploration offers unique advantages. By venturing beyond earth, we gain invaluable knowledge about the universe, including potential resources, celestial threats, and the origin of life. Additionally, space technology often leads to advancements that benefit life on earth, such as satellite communications and medical research in microgravity. It's not an either-or situation; we can pursue both space exploration and understanding our planet.

 **Anonymous**

Your point about space technology leading to innovative scientific discoveries is well received. But, where most economies are concerned, it does boil down to an either-or scenario. And this is the case for countries that are already engaged in space exploration. The USA for example, can afford to send manned vehicles into outer-space, but should they prioritize this billion dollar venture over the extremely pressing concerns of education, healthcare, and security? I would think not.

 **ChatGPT**

You make a valid point about the allocation of resources, and it's true that governments must make tough decisions on budget priorities. However, it's important to note that space exploration can drive technological advancements that benefit various sectors, including education, healthcare, and security. Investments in space technology often have spillover effects, stimulating innovation and economic growth. Additionally, space programs can inspire the next generation of scientists, engineers, and researchers, contributing to education and human capital development. While it requires careful balance, space exploration can indirectly support and enhance other critical areas of national interest.

**FIGURE 6.1** Simulated Debate with ChatGPT

The debate progressed in like fashion until ChatGPT conceded the point. What is significant about this debate is that I would not have naturally opposed the moot but was forced to create arguments against my own deeply held beliefs in real time, in written format, and in a safe and low stakes environment. Any educator with experience can see the powerful learning potential of a simulated dialogue in this fashion.

## Oral Presentations

Effective communication under pressure is a valuable skill honed through presentations and oral examinations. These assessments require students to organize their thoughts, articulate ideas clearly, and respond to questions. Pearce and Chiavaroli (2023) recommend returning to oral examinations as a method of steering away from the pitfalls of students handing in AI generated assignments, but I instead think that AI tools could be enlisted in strengthening practice for oral presentations.

AI tools can be used to generate outlines and talking points based on student-provided keywords or topics. Students can then utilize these AI-generated suggestions as a starting point but must refine and personalize the content to demonstrate their own understanding and critical thinking skills. Furthermore, AI tools capable of speech synthesis could be used to create practice scenarios where students present to a virtual audience, receiving immediate feedback on pacing, clarity, and delivery. This is another form of simulation with the express purpose of preparation for the main assignment.

## Digital Storytelling and Data Visualization

Technology can be harnessed to create assessments that push the boundaries of student creativity and utilize multimodal presentation styles. Digital storytelling projects allow students to express their understanding of the course material through videos, podcasts, or interactive websites. Data visualizations involve taking complex data output and transforming it into easily understood visual formats such

as infographics, concept maps, and process flow diagrams. These formats encourage creativity, research skills, and the ability to tailor communication to a specific audience. For a long time, the barriers to entry for these types of creative expressions were quite high, as they required professional equipment, long stretches of time, and came with steep learning curves. However, multiple AI tools have leveled the playing field and have drastically shortened the gap between the average student and a professional creative.

Digital storytelling projects allow students to express their understanding of the course material creatively. AI tools can be used to generate royalty-free soundtracks or background music that aligns with the chosen theme or historical period of the project. This can enhance the overall production value without compromising on the originality of the students' content or running the risk of copyright violation. Additionally, AI tools can be used to create basic storyboards or visual layouts, which students can then modify and personalize to reflect their own narrative choices.

Creating infographics requires the ability to synthesize information effectively. AI tools can be used to generate preliminary data visualizations based on student-provided data sets. Students can then analyze these visualizations, identify areas for improvement, and refine the graphics to communicate their findings clearly. This allows students to benefit from AI's data processing capabilities while focusing on the critical thinking and analytical skills required to interpret and present the data effectively.

## Summary

The recommendations presented here are by no means exhaustive. They instead serve as broad categories for exploration where multiple opportunities are possible under each of the recommendations. At present, there are no experts or gatekeepers for how to incorporate AI tools into the classroom—there are only those who have tried it, and those who have not tried it yet. As the technology continues to evolve, and instructors continue to broaden their horizons and push the boundaries of assessment design, the only limitations for the field will be defined by our imaginations. The proverbial genie is out of the bottle; we cannot uncreate AI and go back to the time when it did not

exist. Instead, we need to command the direction of influence that this new technology will have on our teaching practice.

One of the most exciting aspects of incorporating AI into assessments is the potential to unleash student creativity. Imagine a history course where students use AI to generate realistic historical dialogue for a re-enactment project, or a science class where students leverage AI to create 3D models of complex molecules for presentations. By providing students with the freedom to explore AI tools within clear ethical guidelines, we empower them to become innovators in educational technology. Of course, this exploration requires careful guidance from instructors to ensure academic rigor and responsible AI use. This collaborative approach, where students push the boundaries of creativity and instructors ensure ethical implementation, holds immense promise for the future of learning.

Ethical considerations for the use of technologies like ChatGPT are also an evolving area. Rather than an immutable set of rules, what needs to exist is an ongoing dialogue between members in the community of practitioners, and also between that community and the wider society. There is no measure that will ever eradicate academic dishonesty completely from the university classroom, and instructors should not have to devolve their classrooms into surveillance camps in pursuit of maintaining ethical standards. Our expertise lies in educating students, not in policing the minority who cheat. The future of integrating this technology into the academic writing arena is one that we can create by ensuring we are mindful, imaginative, and above all else true to our identities as instructors in colleges and universities.

## Discussion Questions

1. How does the rise of AI tools like ChatGPT challenge the effectiveness of traditional essay-based assessments in higher education? What are some of the potential pitfalls that educators must address in maintaining academic integrity?
2. What role should AI play in students' learning processes? How can educators develop guidelines for ethical AI use in coursework, and what challenges do you foresee in implementing these guidelines?
3. The chapter proposes alternative assessments such as portfolios, simulations, and oral presentations. How do these methods address

the limitations of essays in the AI era, and what barriers might educators face in adopting these approaches widely?

4. This chapter discusses how AI-generated content complicates the detection of plagiarism. How can universities redefine plagiarism policies to include AI-generated work, and what strategies can help in distinguishing between legitimate and unethical uses of AI?
5. According to the chapter, student motivations for cheating often stem from grade pressure rather than a desire to learn. How can educators shift the focus from grades to mastery in order to discourage the misuse of AI in academic work?

## Notes

- 1 When student essays started to make use of ChatGPT earlier this year, popular plagiarism detection tools like Turnitin updated their software so that it could detect AI generated essays. This was facilitated by a modified version of ChatGPT called “ChatGPT Zero.” As soon as this happened, new AI software called Quillbot started to appear; this software can rephrase the output from ChatGPT so that it sounds “more human” thereby circumventing plagiarism detection. Essentially, an AI arms race is afoot between cheaters and plagiarism detection.
- 2 April 2024 marked one year of Turnitin using its new AI text detection feature. In a report (Turnitin, 2024) done by the company, it revealed that of the over 200 million essays reviewed, about 22 million (or approximately 11%) contained 20% AI generated text, and 6 million (or approximately 3%) contained up to 80% AI generated text.

## References

Adams Becker, S., Brown, M., Dahlstrom, E., Davis, A., DePaul, K., Diaz, V., & Pomerantz, J. (2018). *NMC horizon report: 2018 higher education edition*. EDUCAUSE.

Berezow, A. (2022, December 8). We gave ChatGPT a college-level microbiology quiz: It blew the quiz away. *Big Think*. <https://bigthink.com/the-future/chatgpt-microbiology-quiz-aced/>

Campbell, S. (2023, June 26). Essay mills explained: What they are and why you should avoid them. *Edvoy*. <https://edvoy.com/articles/essay-mills-explained-what-they-are-and-why-you-should-avoid-them/>

Choi, J. H., Hickman, K. E., Monahan, A., & Schwarcz, D. (2023, January 23). ChatGPT goes to law school. *Journal of Legal Education*. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=4335905](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4335905)

Computer History Museum. (2019, July). John McCarthy. *CHM*. <https://computerhistory.org/profile/john-mccarthy/#:~:text=McCarthy%20coined%20the%20term%20%E2%80%9CAI>

Doran, G. T. (1981). There's a SMART way to write management goals and objectives. *Management Review*, 70(11), 35–36.

Henderson, E. (2015). *The active reader* (3rd ed.). Oxford. (Original work published 2008).

Heyward, E. (2023). *Using AI to write essays isn't cheating, student says*. [www.sporty.co.nz/canta/newsarticle/115524?newsfeedId=1453013](http://www.sporty.co.nz/canta/newsarticle/115524?newsfeedId=1453013)

Hu, K. (2023, February 2). ChatGPT sets record for fastest-growing user base—Analyst note. *Reuters*. [www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/](http://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/)

Kung, T. H., Cheatham, M., Medenilla, A., Sillos, C., De Leon, L., Elepaño, C., Madriaga, M., Aggabao, R., Diaz-Candido, G., Maningo, J., & Tseng, V. (2023). Performance of ChatGPT on USMLE: Potential for AI-assisted medical education using large language models. *PLOS Digital Health*, 2(2), e0000198. <https://doi.org/10.1371/journal.pdig.0000198>

Marche, S. (2022, December 6). The college essay is dead. *The Atlantic*. <https://apple.news/AhbasdW-yQGSKWjfGuaqOmw>

Pearce, J., & Chiavaroli, N. (2023). Rethinking assessment in response to generative artificial intelligence. *Medical Education*, 57(10). <https://doi.org/10.1111/medu.15092>

Pope, D. C. (2001). *Doing school: How we are creating a generation of stressed out, materialistic, and miseducated students*. Paw Prints.

Purdue Writing Lab. (n.d.). *Writing across the curriculum: An introduction*. Purdue Writing Lab. [https://owl.purdue.edu/owl/teacher\\_and\\_tutor\\_resources/writing\\_instructors/writing\\_across\\_the\\_curriculum\\_an\\_introduction/index.html](https://owl.purdue.edu/owl/teacher_and_tutor_resources/writing_instructors/writing_across_the_curriculum_an_introduction/index.html)

Timmis, S., Broadfoot, P., Sutherland, R., & Oldfield, A. (2016). Rethinking assessment in a digital age: Opportunities, challenges and risks. *British Educational Research Journal*, 42(3), 454–476. <https://doi.org/10.1002/berj.3215>

## 142 Teaching and Learning in the Age of Generative AI

Turing, A. (1950). Computing machinery and intelligence. *Mind*, LIX(236), 433–460. <https://doi.org/10.1093/mind/lix.236.433>

Turnitin. (2024, April). *Turnitin marks one year anniversary of its AI writing detector with millions of papers reviewed globally*. [www.turnitin.com/press/press-detail\\_17793](http://www.turnitin.com/press/press-detail_17793)

# Developing Institutional Policies for AI in Education

7

*R. Joel Farrell II, Robin Gosdin Farrell,  
Jendia Grissett, Joni Winter, Amy Pridemore*

## Introduction

The advancing capabilities of the technological landscape has democratized artificial intelligence (AI) and the concepts of machine learning, small learning models and large learning models to the masses. As AI is increasingly integrated into software, tools, and resources, the opportunities and challenges for educational integration have become more prevalent for both institutions and pedagogical practices. AI offers a wide range of possibilities including the potential to enhance personalized learning experiences, streamline administrative processes, and analyze student performance (Ali et al., 2023; Gligoreea et al., 2023). However, the proliferation of AI also creates ethical, legal, and social considerations for administrators, teachers, and students (Bond et al., 2024; Hasanein & Sobaih, 2023) necessitating that institutions balance these opportunities and challenges through well-defined policies. This chapter offers an overview of the literature on the rise of AI in education, covering key topics such as legal compliance, data privacy and security, ethics, bias mitigation, transparency and accountability, accessibility and inclusivity, interdisciplinary collaboration, professional development, and continuous evaluation and improvement. Additionally, it provides guidelines for developing an AI policy in higher education.

## The Rise of AI in Education

Over the past few decades, AI has made significant advancements in various fields, including education (Al Samman, 2024; Alshammari & Alshammari, 2024; Nguyen, 2023; Tanveer et al., 2020). AI has been applied to educational resources to enhance student skills, affording teachers increased time and flexibility to cultivate deeper understanding, adaptability, and overall performance improvements (Zawacki-Richter et al., 2019). These advancements have led to the development of intelligent tutoring systems, virtual reality simulations, and personalized learning algorithms, among other applications (Ali et al., 2023; Cotton et al., 2024; Gligorea et al., 2023; Nguyen, 2023). The potential of AI in education extends beyond these applications, with possibilities such as intelligent content creation, adaptive assessments, and intelligent learning analytics. AI has the potential to revolutionize education by automating administrative tasks and increasing student engagement (Almusaed et al., 2023; McArthur, 2023; Perkins et al., 2023). Additionally, it can evolve teaching and learning practices, models, and processes through personalized learning experiences, machine learning, gaming, and simulation experiences (Alshammari & Alshammari, 2024; Cotton et al., 2024; Kramm & McKenna, 2023). While AI in education offers significant benefits, it is important to consider the potential negative impacts of this technology within educational settings (Anders, 2023; Cotton et al., 2024; Denecke et al., 2023; Kramm & McKenna, 2023). One of the main concerns is the potential for AI algorithms to perpetuate and even exacerbate existing biases and inequalities (Selwyn, 2010). Despite efforts to mitigate bias in AI-driven systems, complete elimination of bias remains a significant challenge. This raises concerns about the potential for discriminatory outcomes and unfair treatment of certain student groups.

Additionally, the reliance on AI technology in education may lead to a depersonalization of the learning experience. As AI becomes more prevalent, there is a risk that it may replace meaningful human interaction and personalized guidance from educators. This depersonalization could hinder the development of critical thinking, creativity, and interpersonal skills, which are essential for students' holistic development (Bond et al., 2024; Cotton et al., 2024; Kramm & McKenna,

2023). Moreover, the integration of AI technology in education raises concerns about data privacy and security. While policies aim to prioritize the safeguarding of student information, the use of AI inevitably involves the collection and analysis of large volumes of student data. This accumulation of data may create vulnerabilities and privacy risks, especially if not managed appropriately. There is also the risk of unauthorized access or breaches that could compromise the privacy of students and expose them to various forms of exploitation (Denecke et al., 2023; Farrelly & Baker, 2023). Another important consideration is the potential for job displacement among educators. According to Kramm and McKenna (2023), as AI technology continues to advance, there is a possibility that certain educational tasks traditionally performed by educators could be automated, leading to concerns about job security and the overall role of educators in the learning environment.

Despite these challenges, the integration of AI can be leveraged to improve educational outcomes, institutional processes, and educational practices. The integration of AI may impact the entire institution—students, faculty, and staff—and must be carefully examined for the positive and negative impacts to the overall learning environment. Therefore, it is important to develop policies to ensure that the integration of AI is balanced and beneficial for all stakeholders (Hasanein & Sobaih, 2023; Kramm & McKenna, 2023). The successful integration of AI requires careful attention to legal compliance, ethical considerations, bias mitigation, data privacy, and the balance between technology and human interaction (Bansal et al., 2023; Cotton et al., 2024; Denecke et al., 2023; Li, 2020; Perkins et al., 2023; Selwyn, 2010).

## Developing Institutional Policies for AI in Education: General Considerations

Developing institutional policies for AI in education helps to ensure the responsible and effective use of AI technologies in educational settings. These policies should address the areas of legal compliance, data privacy and security, ethical considerations, bias mitigation, transparency and accountability, accessibility and inclusivity, interdisciplinary

collaboration, professional development, and continuous evaluation and improvement. (Association for the Advancement of Artificial Intelligence, 2023; Baker & Hawn, 2021; Borenstein & Howard, 2021; Borenstein et al., 2020; Tong et al., 2024; Zhai et al., 2021; Zhang & Aslan, 2021). These will be addressed in the sections below.

### *Legal Compliance*

AI policies should start with a foundation of the relevant laws and regulations. This includes privacy and information protection laws, such as the *Family Educational Rights and Privacy Act (FERPA)* in the United States and the *General Data Protection Regulation (GDPR)* in the European Union. The legal and regulatory section should also address intellectual property, as well as patent and copyright of AI-generated teaching and learning materials.

### *Data Privacy and Security*

Data privacy and security are critical considerations when developing institutional policies for AI in education. Stakeholders must establish policies that prioritize the safeguarding of sensitive student information by outlining guidelines for secure data storage, access control, encryption, and data retention. Policies should address protocols for data sharing and third-party access, ensuring robust measures are in place to protect the privacy and information of students, faculty, and staff, and prevent unauthorized use or disclosure. This includes policies aligned to compliance with data protection regulations, secure data storage and transmission practices, and obtaining informed consent regarding the collection and usage of data. Additionally, clear guidelines for data sharing and retention, as well as limiting data access to authorized personnel, should be established. Institutions should clearly differentiate between business-related data usage, such as modeling for recruiting and admissions, and academic research conducted by scholars. These measures should also include regular monitoring, evaluation, and audits of data privacy and security (Denecke et al., 2023; Farrelly & Baker, 2023).

### *Ethical Considerations*

The ethical implications of using AI technologies encompass a broad range of concerns, extending beyond legal compliance and data privacy to include other fundamental areas (Anders, 2023; Bond et al., 2024; Cotton et al., 2024; Holmes et al., 2021; Perkins et al., 2023). These ethical considerations include equity and fairness, data collection and usage, data ownership and privacy, and bias mitigation. Other considerations include transparency and accountability, plus accessibility and inclusivity.

Higher education institutions, entrusted by society, have an obligation to carefully assess and evaluate the ethical concerns associated with AI technologies. For example, while the capacity of AI to consume, analyze, and model large quantities of data offers significant benefits to society, institutions, and individuals, it also carries the potential for harm. The historical record of human subjects' research provides witness to the need for clear policies addressing data collection and use (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979).

The potential for AI application across the administrative, operational, instructional, co-curricular, and extra-curricular areas of institutions is tremendous. Institutions should consider the core principles of ethics—respect for autonomy; non-maleficence; beneficence; and justice—in the process of assessing and evaluating policies (Beauchamp & Childress, 2013). With these guiding principles, policies should address the potential risks and harms associated with AI use in higher education. In application, it is important to implement pragmatic processes, such as informed consent, before placing admission application data into an AI algorithm (Association for the Advancement of Artificial Intelligence, 2023; Borenstein & Howard, 2021; Holmes et al., 2021; Li, 2020; Vincent-Lancrin & Vlies, 2020).

### *Bias Mitigation*

Addressing bias in AI algorithms is a crucial aspect of developing institutional policies for AI in education. Educators and developers must

work together to prevent bias in AI-driven systems, ensuring that they provide fair and equitable educational experiences for all students (Selwyn, 2010). Regular monitoring, evaluation, and audits of AI systems are necessary to identify and address any biases or unintended consequences. The potential of AI algorithms to automate processes reaches across the entire lifecycle of students, faculty, and staff. The implementation of AI to model decisions must be carefully managed to minimize and prevent algorithmic bias and discriminatory outcomes. It is important to remember that AI processes and algorithms are based on existing data, thus the principle of *garbage in, garbage out* must be carefully considered (Baker & Hawn, 2021; Holmes et al., 2021; Li, 2020; Vincent-Lancrin & Vlies, 2020).

### *Transparency and Accountability*

Transparency and accountability are fundamental principles that should also be embedded in institutional policies for AI in education. Transparency includes providing clear explanations of how AI algorithms make decisions or recommendations, as well as being transparent about the data collection and processing methods used by AI systems. This transparency not only fosters trust among students, faculty, and staff, but also supports the identification and addressing of any biases or inaccuracies within the AI algorithms. As a result, policies must guide or establish protocols for transparency in the AI processes and particularly areas influencing decision-making. This includes providing clear explanations of how AI systems operate, the data sources they rely on, and how decisions are made. Additionally, policies should define the roles and responsibilities of various stakeholders, including administrators, faculty, staff, and students, in overseeing its use (Hasanein & Sobaih, 2023; Kramm & McKenna, 2023; Li, 2020; Selwyn, 2010). Moreover, institutional policies should outline the specifics of accountability, including who is responsible, what actions are accountable, and how accountability is ensured, by establishing mechanisms for oversight, audits, and reviews. For example, this may involve creating committees dedicated to continuously reviewing and assessing both current AI accountability practices and the evolving implications of AI on accountability standards.

## *Accessibility and Inclusivity*

The integration of AI in the institutional environment should also be viewed through the lens of accessibility and inclusivity. The capacity of AI to provide personalized or tailored engagement in teaching, learning, and operations requires consideration of faculty, staff, and students' diverse needs. Policies for integrating AI solutions should consider the unique characteristics of each institution (Ali et al., 2023). For some institutions, prioritization of AI solutions may focus on operations, while for others it may be in student support, recruitment, or other areas. Institutional policies should reflect the unique characteristics of the institution and balance AI integration with human engagement to enhance accessibility and inclusivity (Almusaed et al., 2023; Holmes et al.; 2021; Li, 2020; Selwyn, 2010; Zhai et al., 2021).

The use of AI supported tools in teaching and learning has been pursued since the 1960s (Page, 1966). The capacity of AI to consume data related to feedback and instruction has created the reality of AI-generated feedback and tutoring (Mousavinasab et al., 2021). The potential benefit to the instructor and the learner is profound. AI-provided formative assessment feedback in real time to a learner increases the accessibility to the learning process.

The potential challenges are equally profound. Imagine a biased model provided the AI feedback to the learner—this could be not only incorrect feedback but could also be skewed against the learner. In addition to potential bias, the proliferation of AI tools raises questions about tool usage, price, licensing, accuracy, etc. The embedding of AI tools within other applications such as Grammarly, CoPilot, Gemini, etc. increases accessibility, but also decreases awareness of the AI tool. A few exemplar institutions such as the University of Michigan (2024) have applied the institution's policy and values for accessibility, equity, and inclusion with institution-owned AI platforms. Other institutions have established committees or working groups to examine the appropriate use of AI for the institution (University of Arizona, 2024).

## *Interdisciplinary Collaboration*

The policies should also promote collaboration across stakeholders and disciplines within the institution (Alshammari & Alshammari, 2024;

Li, 2020; Selwyn, 2010). The engagement of faculty, technologists, ethicists, administrators, and staff is vital to the integration of AI in the culture of the institution. The collaborative approach brings diverse perspectives to the table, facilitating the creation of well-informed policies that consider the broader challenges, benefits, and implications of AI integration (Alshammari & Alshammari, 2024; Anders, 2023; Li, 2020). Considering multiple viewpoints and engaging in open dialogue allows stakeholders to collectively develop policies for AI integration that account for its impact on the institution and its members, fostering a shared understanding of the potential benefits and challenges. Stakeholders can also work together to address concerns such as bias, transparency, accountability, privacy, security, and use of AI systems. They can also develop a shared understanding in the establishment of mechanisms for monitoring and evaluating the implementation of AI to ensure its effectiveness and compliance with established policies (Kramm & McKenna, 2023; Zhai et al., 2021).

Institutional policies should provide a framework for continuous engagement of faculty, staff, and students in cross-disciplinary collaboration on AI use in teaching, learning, and operations. This includes ongoing monitoring of the evolving AI environment, understanding AI's impact, identifying issues, adapting policies, and integrating AI while upholding beneficence and non-maleficence. This approach to collaboration helps ensure AI is utilized in a manner that respects the autonomy, privacy, and well-being of faculty, staff, and students, while promoting equality and fairness in educational outcomes (Zhai et al., 2021).

### *Professional Development*

In developing institutional policies for AI in education, support for professional development, training, and if required reskilling of faculty, staff, and students should be considered (Holmes et al., 2021; Li, 2020). Policies should emphasize the roles of educators and learners in the use of AI technologies, highlighting the faculty's role in guiding and supervising AI tools in the learning environment. They should support faculty in aligning AI use with learning outcomes, instructional delivery, and student learning. Additionally, policies should promote awareness

of AI as a component of digital literacy, encouraging faculty, staff, and students to understand, critically engage with, and use AI responsibly.

Professional development, training, and reskilling initiatives can support faculty and staff in effectively integrating AI into teaching. These initiatives should focus on providing the necessary knowledge and skills to leverage AI tools for course design, development, and delivery, while reinforcing learning outcomes. Additionally, reskilling initiatives can help educators adapt to the changing educational landscape by providing resources and support for integrating emerging technologies, including AI, into their pedagogical approaches. This may involve offering mentorship programs, learning communities, and access to experts in the field of AI and education. Professional development programs focusing on AI integration, appropriate use, and data privacy will empower faculty and staff to leverage AI responsibly (Alshammari & Alshammari, 2024; Holmes et al., 2021; Li, 2020).

As part of professional development, faculty and staff should be granted environments to innovate and experiment with AI for teaching, learning, and operations. For example, faculty could be trained on how to effectively utilize AI-driven insights in their lesson planning, differentiating instruction, and providing personalized learning experiences for students (Ali et al., 2023; Gligorea et al., 2023). However, they should also be provided the space to test, experiment, and research with AI. In combination with interdisciplinary collaboration, professional development initiatives can contribute to the creation of a supportive and adaptable educational environment that meets the evolving needs of the institution, faculty, staff, and students (Holmes et al., 2021; Li, 2020).

### *Continuous Evaluation and Improvement*

Institutional policies for AI in education should encompass mechanisms for continuous evaluation and improvement. This involves establishing frameworks for ongoing assessment of the impact and effectiveness of AI technologies in supporting teaching, learning, and operations. The application of continuous evaluation processes to AI can support decisions on current and future AI use as well as current policies,

processes, practices, and policy changes (Bansal et al., 2023; McArthur, 2023). The general considerations for AI demand a comprehensive approach to development of institutional policies that addresses ethical, legal, and practical issues. By establishing clear guidelines, institutions can harness the potential of AI, while safeguarding the well-being and rights of faculty, students, and staff. Moreover, clear policies can foster a culture of transparency, continuous evaluation, and collaboration between stakeholders for the responsible integration of AI (Bansal et al., 2023).

### Practical Guidance for Development, Implementation, Utilization, and Enforcement of AI Policies

The development, implementation, utilization, and enforcement of AI-specific policies should adhere to each institution's established processes, procedures, and practices for policy management. In that context, key practical areas that may not be covered by existing processes should be examined for inclusion in the AI policy framework. The following guidelines are consolidated from across principles of data governance and management and higher education (DAMA International, 2024; Davis, 2023; Sabado, 2024). These can help support successful AI development, implementation, utilization, and enforcement (Holmes et al., 2021; Li, 2020; Sabado, 2024; Zhai et al., 2021).

1. **Establish Clear Objectives.** Clearly define the goals and objectives of integrating AI for the teaching, learning, and operations at the institution. This provides a clear focus and direction for policy.
2. **Define Stakeholder Engagement.** Define the stakeholders, including faculty, administrators, staff, students, technology experts, etc. for AI integration across the institution, and if relevant, external to the institution. This provides a path to framing stakeholder engagement and supporting diverse perspectives leading to more effective policies.
3. **Define Ethical Guidelines/Principles.** Define a set of ethical guidelines and principles that address common principles of beneficence, maleficence, algorithmic transparency, fairness, accountability, and the autonomy to structure the guidelines for data privacy, etc.

4. **Include Data Governance.** Include clear implementation of robust data governance practices for AI to ensure the responsible collection, storage, and use of data. This includes establishing clear consent and data sharing protocols, cybersecurity measures, and regular audits to ensure compliance with privacy regulations.
5. **Develop Data Privacy Policies.** Include specific robust data privacy policies that outline how data will be collected, stored, and used in AI systems. These policies should adhere to relevant laws and regulations, such as the FERPA and GDPR, and should prioritize the protection of personal information and ensure their privacy rights are respected.
6. **Ensure Bias Mitigation and Equity.** Establish processes to review and evaluate the AI algorithms for bias and equitable influence outcomes and experiences. This supports regular monitoring, evaluation, and audits of AI systems to identify and address any biases or unintended consequences.
7. **Establish Clear Guidelines for AI Use.** Develop clear guidelines and protocols for the development, deployment, and use of AI technology. These guidelines should cover aspects such as the appropriate use of AI tools, responsibilities and roles of developers and users, potential risks and challenges, and steps to mitigate those risks.
8. **Establish Technology Assessment and Vetting.** Develop clear guidelines for the review of technology infrastructure, software, tools, and resources. This helps stakeholders understand the ramifications of implementing AI tools on the existing infrastructure.
9. **Establish a Recourse Catalog of Approved AI Tools.** Develop a process to support a catalog of approved AI tools for application across the institution. This catalog allows faculty, staff, and students to know which tools have been reviewed and vetted for appropriate use, security, etc.
10. **Establish Data-Driven Decision-Making Parameters.** Establish the parameters of AI use to analyze large data sets to inform institutional decision-making. These parameters guide the incorporation of AI-generated insights and define the areas where these insights will be applied in teaching, learning, and operations across the institution.
11. **Define Transparency and Accountability.** Define the guidelines to ensure transparency in the use of AI across the institution. This

includes transparency of data collection, data processing, and data algorithms used in decisions or recommendations.

12. **Implement Continuous Monitoring and Evaluation.** Establish clear processes to regularly monitor and evaluate the use of AI and the implementation of policies to identify any unintended consequences or biases. This can be done through data analysis, feedback from stakeholders, and ongoing assessment of objectives and outcomes.
13. **Provide Professional Development.** Establish professional development opportunities to enhance stakeholders' AI knowledge and skills and its applications in teaching, learning, and operations, thereby fostering an understanding of AI's potential across the institution.

## Practical Guidance for Institutional Culture

AI has the potential to change the institutional environment and culture, including the nature of curriculum design, instruction delivery, learning engagement, and student engagement (García-Martínez et al., 2023; Gillani et al., 2022; Kadaruddin, 2023; Kamalov et al., 2023; Latif et al., 2023; Mallik & Gangopadhyay, 2023). The challenges and opportunities of AI can create concerns and in some cases fear among the greatest assets of an institution—its people. To address this, institutions should consider additional practical areas to guide development, implementation, utilization, and enforcement of the AI policies. The following additional areas compiled from best practices across institutions can help to provide a positive influence on institutional culture and engage people in collaboration across the institution (Bond et al., 2024; Kadaruddin, 2023; Karmakar, 2023; Li, 2020; Sabado, 2024).

1. **Establish an AI Committee.** Establish an AI committee to focus on AI policies, implementation, utilization, and enforcement. This will facilitate addressing the implications of AI across the institution with a knowledgeable interdisciplinary team.
2. **Establish a Living AI Framework.** Establish a framework to support an adaptive, flexible, and evolving AI policy. This supports addressing the rapid changes in the AI landscape, technology, platforms, and tools as they evolve.

3. **Establish a Balanced Approach to AI.** Establish a framework to ensure a balance between the AI use and the human touch in education. AI can analyze large quantities of data, automate routine tasks, provide patterns of engagement, and accelerate processes, etc. However, it is not a panacea for all institutional, teaching, or learning functions. AI must be viewed as a tool to support the work of faculty, staff, and students instead of replacing them. Human engagement is irreplaceable in terms of mentorship, emotional support, social interaction, and emotional skills.
4. **Develop a Culture of Innovation.** Develop a framework to support innovation, experimentation, research, and risk-taking to explore new ways AI can improve the institution, teaching, and learning. This will provide the faculty, staff, and students with a space to create, pilot, test, evaluate, etc. without the fear of failure limiting them.
5. **Develop AI Learning Communities.** Establish a framework to support professional learning communities focused on AI integration. This can facilitate ongoing discussions, knowledge sharing, and the dissemination of best practices. These communities can serve as platforms for faculty, staff, and students to collaborate, learn from each other's experiences, and stay updated on the latest developments in AI education.
6. **Foster Collaboration and Partnerships with Industry and Researchers.** Develop a framework to foster collaboration with industry experts and research partners in the rapidly evolving advancements of AI. This will allow institutions to leverage cutting-edge AI tools and techniques to enhance teaching and learning experiences.

The general considerations and practical guidance provided above offer a flexible framework applicable to a wide range of institutions, assisting stakeholders in critically examining and reflecting on AI integration. They can be tailored to reflect the mission, purpose, vision, goals, and culture of each institution (Kramm & McKenna, 2023).

## Policies for Integration of AI in Education: Current Trends and Future Predictions

The integration of AI in institutions has the potential to improve administrative and operation efficiency, enhance faculty, staff, and student

engagement and experiences, and promote curricular, co-curricular, and extra-curricular outcomes (Al Samman, 2024; Bansal et al., 2023; García-Martínez et al., 2023; Kamalov et al., 2023; Latif et al., 2023). As the field of AI continues to evolve, the future of AI policy in education is likely to witness emerging trends and developments. The integration of AI has already served as a disrupter to education and its future promises even more transformative changes to administrative and educational processes (Baker & Hawn, 2021; Chaudhry & Kazim, 2021; Gillani et al., 2022; Kadaruddin, 2023; Karmakar, 2023). Consequently, educational institutions must remain proactive in anticipating and adapting to AI trends to ensure policies remain relevant and responsive to the evolving educational landscape. Examining current AI integration offers insights into trends shaping present policies and helps predict future needs, and involves exploring advanced AI technologies, such as adaptive learning systems and intelligent tutoring platforms, while addressing associated ethical considerations. The emergence of new data privacy regulations and ethical frameworks specific to AI in education may necessitate revising and augmenting existing AI policies to align with evolving legal and ethical standards. Educational institutions should proactively engage in ongoing dialogue and collaboration with regulatory authorities and industry stakeholders to stay abreast of emerging trends and insights in AI policy and education (Tanveer et al., 2020; Zawacki-Richter et al., 2019; Zeide, 2019; Zhang & Aslan, 2021). The nascent state of institutional policies reflects the complexity AI creates across the institution's stakeholders.

## Summary

In conclusion, the current state of AI and the future of AI require institutions to engage in continuous review, adaptation, and response to emerging AI trends and advancements. Institutions will face continual challenges to balance the capabilities of AI with practical applications. It is recommended that institutional leaders proactively develop policies in response to AI advancements to help support and protect the interests of the institution, faculty, staff, and students. Institutional leaders should seek to balance the challenges, opportunities, benefits, limitations, and risks of AI through clear and evolving policies to foster an appropriate AI ecosystem for the institution and its stakeholders. Institutional

policies should promote ethical awareness and critical inquiry among all stakeholders, supporting thoughtful engagement with AI solutions and ensuring ethically sound decisions for AI's use. This will help forge a culture of data ethics and responsible use that applies to the current AI landscape and will adapt to the future. In summary, these policies should also lead in promoting a culture of continuous learning and open dialogue to navigate the complexities of AI integration while safeguarding the well-being of faculty, staff, and students.

## Discussion Questions

1. How can institutions ensure that the integration of AI in education enhances, rather than diminishes, the value of human interaction in teaching and learning? What strategies can be implemented to maintain a balance between AI-driven efficiencies and the need for personalized, human-centered educational experiences?
2. Considering the ethical challenges associated with AI, such as bias and data privacy, how should institutions prioritize these concerns when developing AI policies? What role should educators play in shaping policies that uphold ethical standards while fostering innovation?
3. How can institutions effectively engage stakeholders across disciplines in the development and implementation of AI policies? What are the potential challenges and benefits of such interdisciplinary collaborations?
4. How can institutions create a culture of continuous evaluation and adaptation in response to the evolving AI landscape? What mechanisms should be in place to regularly assess the impact of AI on teaching, learning, and institutional practices?
5. What professional development opportunities should institutions provide to ensure that faculty and staff are adequately prepared to leverage AI technologies? How can these initiatives promote responsible and informed use of AI in education?

## References

Ali, F., Choy, D., Divaharan, S., Tay, H., & Chen, W. (2023). Supporting self-directed learning and self-assessment using TeacherGAIA, a generative

AI chatbot application: Learning approaches and prompt engineering. *Learning: Research and Practice*, 9(2), 135–147. <https://doi.org/10.1080/23735082.2023.2258886>

Almusaed, A., Almssad, A., Yitmen, İ., & Homod, R. (2023). Enhancing student engagement: Harnessing “AIED”’s power in hybrid education—A review analysis. *Education Sciences*, 13(7), 632. <https://doi.org/10.3390/educsci13070632>

Al Samman, A. (2024, January). Harnessing potential: Meta-analysis of AI integration in higher education. In *International Conference in Emerging Technologies for Sustainability and Intelligent Systems (ICETESIS)* (pp. 1–7). doi:10.1109/ICETESIS61505.2024.10459420.

Alshammari, S., & Alshammari, M. (2024). Factors affecting the adoption and use of ChatGPT in higher education. *International Journal of Information and Communication Technology Education*, 20(1), 1–16. <https://doi.org/10.4018/IJICTE.339557>

Anders, B. (2023). Is using ChatGPT cheating, plagiarism, both, neither, or forward thinking? *Patterns*, 4(3), 100694. <https://doi:10.1016/j.pat.ter.2023.100694>.

Association for the Advancement of Artificial Intelligence. (2023). *AAAI Ethics and Diversity*. <https://aaai.org/about-AAAI/ethics-and-diversity/>

Baker, R. S., & Hawn, A. (2021, November 18). Algorithmic bias in education. *International Journal of Artificial Intelligence in Education*, 32(4), 1052–1092. <https://doi.org/10.1007/s40593-021-00285-9>

Bansal, G., Mitchell, A., & Li, D. (2023). A panel report on higher education in the age of AI from the perspective of academic leaders in the Midwest US. *Communications of the Association for Information Systems*, 54, 360–375. <https://doi.org/10.17705/1CAIS.05413>

Beauchamp, T. L., & Childress, J. F. (2013). *Principles of biomedical ethics* (7th ed.). Oxford University Press.

Bond, M., Khosravi, H., De Laat, M., Bergdahl, N., Negrea, V., Oxley, E., Pham, P., Chong, S., & Siemens, G. (2024). A meta systematic review of artificial intelligence in higher education: A call for increased ethics, collaboration, and rigour. *International Journal of Educational Technology in Higher Education*, 21(4). <https://doi.org/10.1186/s41239-023-00436-z>

Borenstein, J., & Howard, A. (2021). Emerging challenges in AI and the need for AI ethics education. *AI Ethics*, 1, 61–65. <https://doi.org/10.1007/s43681-020-00002-7>

Borenstein, J., Mahajan, H., Wagner, A. R., & Howard, A. M. (2020). Trust and pediatric exoskeletons: A comparative study of clinician and parental

perspectives. *IEEE Transactions on Technology and Society*, 1(2), 83–88. <https://doi.org/10.1109/tts.2020.2974990>

Chaudhry, M., & Kazim, E. (2021). Artificial intelligence in education (AIEd): A high-level academic and industry note 2021. *AI Ethics*, 2, 157–165. <https://doi.org/10.1007/s43681-021-00074-z>

Cotton, D. R. E., Cotton, P. A., & Shipway, J. R. (2024). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International*, 61(2), 228–239. <https://doi.org/10.1080/14703297.2023.2190148>

DAMA International. (2024). *The DAMA guide to the data management body of knowledge (DAMA-DMBOK guide)* (2nd ed. revised). Technics Publications.

Davis, V. (2023). *Developing institutional level AI policies and practices: A framework*. WICHE Cooperative for Educational Technologies. <https://wcet.wiche.edu/frontiers/2023/12/07/developing-institutional-level-ai-policies-and-practices-a-framework/>

Denecke, K., Glauser, R., & Reichenpfader, D. (2023). Assessing the potential and risks of AI-based tools in higher education: Results from an eSurvey and SWOT analysis. *Trends in Higher Education*, 2(4), 667–688. <https://doi.org/10.3390/higheredu2040039>

Farrelly, T., & Baker, N. (2023). Generative artificial intelligence: Implications and considerations for higher education practice. *Education Sciences*, 13(11), 1109. <https://doi.org/10.3390/educsci13111109>

García-Martínez, I., Batanero, J., Fernández-Cerero, J., & León, S. (2023). Analyzing the impact of artificial intelligence and computational sciences on student performance: Systematic review and meta-analysis. *Journal of New Approaches in Educational Research*, 12(1), 171–171. <https://doi.org/10.7821/naer.2023.1.1240>

Gillani, N., Eynon, R., Chiabaut, C., & Finkel, K. (2022). Unpacking the “black box” of AI in education. *Educational Technology & Society*, 26(1), 99–111. <https://doi.org/10.48550/arxiv.2301.01602>

Gligore, I., Cioca, M., Oancea, R., Gorski, A., Gorski, H., & Tudorache, P. (2023). Adaptive learning using artificial intelligence in e-learning: A literature review. *Education Sciences*, 13(12), 1216. <https://doi.org/10.3390/educsci13121216>

Hasanein, A., & Sobaih, A. (2023). Drivers and consequences of ChatGPT use in higher education: Key stakeholder perspectives. *European Journal of Investigation in Health, Psychology and Education*, 13(11), 2599–2614. <https://doi.org/10.3390/ejihpe13110181>

Holmes, W., Porayska-Pomsta, K., Holstein, K., Sutherland, E., Baker, T., Shum, S., Santos, O., Rodrigo, M., Cucurova, M., Bittencourt, I., & Koedinger, K. (2021). Ethics of AI in education: Towards a community-wide framework. *International Journal of Artificial Intelligence in Education*, 32, 504–526. <https://doi.org/10.1007/s40593-021-00239-1>

Kadaruddin, K. (2023). Empowering education through generative AI: Innovative instructional strategies for tomorrow's learners. *International Journal of Business, Law, and Education*, 4(2), 618–625. <https://doi.org/10.56442/ijble.v4i2.215>

Kamalov, F., Calonge, D., & Gurrib, I. (2023). New era of artificial intelligence in education: Towards a sustainable multifaceted revolution. *Sustainability*, 15, 12451. [www.mdpi.com/2071-1050/15/16/12451/pdf?version=1692181759](http://www.mdpi.com/2071-1050/15/16/12451/pdf?version=1692181759)

Karmakar, S. (2023, June 4). Artificial intelligence and education: Revolutionizing learning for the future. *Medium*. <https://santu1x.medium.com/artificial-intelligence-and-education-7c4d2262310>

Kramm, N., & McKenna, S. (2023). AI amplifies the tough question: What is higher education really for? *Teaching in Higher Education*, 28(8), 2173–2178. <https://doi.org/10.1080/13562517.2023.2263839>

Latif, E., Mai, G., Nyaaba, M., Wu, X., Liu, N., Lu, G., Li, S., Liu, T., & Zhai, X. (2023, April 24). AGI: Artificial general intelligence for education. *arXiv:2304.12479 [cs.AI]*, [v1]. <https://doi.org/10.48550/arxiv.2304.12479>

Li, X. (2020). The dilemma and countermeasures of AI in educational application. In *Proceedings of the 2020 4th International Conference on Computer Science and Artificial Intelligence*. ACM. <https://doi.org/10.1145/3445815.3445863>

Mallik, S., & Gangopadhyay, A. (2023). Proactive and reactive engagement of artificial intelligence methods for education: A review. *Frontiers in Artificial Intelligence*, 6. <https://doi.org/10.3389/frai.2023.1151391>

McArthur, J. (2023). Rethinking authentic assessment: Work, well-being, and society. *Higher Education*, 85(1), 85–101. <https://doi.org/10.1007/s10734-022-00822-y>

Mousavinasab, E., Zarifsanaiey, N. R., Niakan Kalhori, S., Rakhshan, M., Keikha, L., & Ghazi Saeedi, M. (2021). Intelligent tutoring systems: A systematic review of characteristics, applications, and evaluation methods. *Interactive Learning Environments*, 29(1), 142–163. <https://doi.org/10.1080/10494820.2018.1558257>

National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. (1979). *The Belmont Report: Ethical principles and guidelines for the protection of human subjects of research*. US Department of

Health and Human Services. [www.hhs.gov/ohrp/regulations-and-policy/belmont-report/read-the-belmont-report/index.html](http://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/read-the-belmont-report/index.html)

Nguyen, N. (2023). Exploring the role of AI in education. *London Journal of Social Sciences*, 6, 84–95. <https://doi.org/10.31039/ljss.2023.6.108>

Page, E. B. (1966). The imminence of grading essays by computer. *Phi Delta Kappan*, 47(5), 238–243. [www.jstor.org/stable/20371545](http://www.jstor.org/stable/20371545)

Perkins, M., Furze, L., Roe, J., & MacVaugh, J. (2023). Navigating the generative AI era: Introducing the AI assessment scale for ethical GenAI assessment. [arXiv:2312.07086](https://arxiv.org/abs/2312.07086). <https://arxiv.org/abs/2312.07086>

Sabado, J. (2024). ChatGPT, AI, and higher education. *Joe Sabado—Higher Education & Technology Leadership*. <https://joesabado.com/2024/06/chat-gpt-ai-and-higher-education/>

Selwyn, N. (2010). Degrees of digital division: Reconsidering digital inequalities and contemporary higher education. *Universities and Knowledge Society Journal*, 7(1), 33–42. [www.redalyc.org/articulo.oa?id=78012953011](http://www.redalyc.org/articulo.oa?id=78012953011)

Tanveer, M., Hassan, S., & Bhaumik, A. (2020). Academic policy regarding sustainability and artificial intelligence (AI). *Sustainability*, 12(22), 9435–9435. <https://doi.org/10.3390/su12229435>

Tong, R., Li, H., Liang, J., & Qingsong, W. (2024). Developing and deploying industry standards for artificial intelligence in education (AIED): Challenges, strategies, and future directions. [arXiv:2403.14689](https://arxiv.org/abs/2403.14689). <https://arxiv.org/abs/2403.14689>

University of Arizona. (2024). *Artificial intelligence at the University of Arizona*. <https://artificialintelligence.arizona.edu/>

University of Michigan. (2024). *Information and technology services: AI services*. <https://its.umich.edu/computing/ai>

Vincent-Lancrin, S., & Vlies, R. (2020, April 8). Trustworthy artificial intelligence (AI) in education. *OECD Education Working Papers*. [www.oecd-ilibrary.org/education/trustworthy-artificial-intelligence-ai-in-education\\_a6c90fa9-en;jsessionid=dy2TD8yZnRd3pW9wSCpMWEPG.ip-10-240-5-70](http://www.oecd-ilibrary.org/education/trustworthy-artificial-intelligence-ai-in-education_a6c90fa9-en;jsessionid=dy2TD8yZnRd3pW9wSCpMWEPG.ip-10-240-5-70)

Zawacki-Richter, O., Marín, V., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education—Where are the educators? *International Journal of Educational Technology in Higher Education*, 16(39). <https://doi.org/10.1186/s41239-019-0171-0>

Zeide, E. (2019). Artificial intelligence in higher education: Applications, promise and perils, and ethical questions. *EDUCAUSE Review*, 54(3). <https://er.educause.edu/articles/2019/8/artificial-intelligence-in-higher-education-applications-promise-and-perils-and-ethical-questions>

Zhai, X., Chu, X., Chai, C., Jong, M., Istenic, A., Spector, M., Liu, J., Jing, Y., & Li, Y. (2021). A review of artificial intelligence (AI) in education from 2010 to 2020. *Complexity*. 1–18. <https://doi.org/10.1155/2021/8812542>

Zhang, K., & Aslan, A. B. (2021). AI technologies for education: Recent research & future directions. *Computers and Education: Artificial Intelligence*, 2, 100025. <https://doi.org/10.1016/j.caeai.2021.100025>

# Navigating Risks: Inaccuracies, Bias, Disinformation, and Privacy in Educational AI

8

*Krzysztof Walczak, Wojciech Cellary*

## Introduction

To enhance teaching and learning efficiency, educators continually integrate emerging technologies into educational settings as they become available. This trend is not merely about keeping up with technological progress; it has shown clear benefits in most cases in the past. Over time, one could observe how new technologies not only support diverse learning style preferences, but also improve accessibility, engagement, and understanding across various subjects. Schools, colleges, and universities continue to leverage these innovations, aiming to provide students with the most effective and up-to-date educational experiences possible.

Currently, artificial intelligence, particularly generative AI, stands at the forefront of these changes in educational technology. This form of AI, capable of producing rich, tailored content, from textual material to complex multimedia presentations, is reshaping the pedagogical landscape. Its impact on both teaching and learning is profound. Educators are empowered with tools that can quickly and easily create customized learning materials, while students benefit from interactive and personalized educational experiences. However, the integration of generative AI in educational settings also presents several risks that must

be carefully managed. One significant concern is the potential for inaccuracies in AI-generated content, which can mislead students or propagate misunderstandings if not properly identified. Additionally, these systems may inherit and amplify biases present in their training data, leading to unfair or skewed educational materials that could influence learners' perspectives. There is also the risk of disinformation, especially if the AI tools are manipulated to generate false or misleading information as part of educational content. Finally, privacy issues arise when these technologies handle sensitive student data to personalize learning experiences, potentially leading to breaches or misuse of personal information. Addressing these risks can help ensure that the benefits of AI in education can be realized without detrimental effects on student learning and safety.

In this chapter, we examine the most significant risks associated with the use of generative AI in educational contexts, specifically focusing on inaccuracies, biases, disinformation, and privacy concerns. We detail the mechanisms through which these risks manifest and discuss a range of strategies designed to mitigate their impact. By demonstrating practical examples, we highlight the challenges and discuss best practices in managing these issues effectively. The chapter also highlights the critical importance of integrating educational strategies that enhance users' understanding and critical engagement with AI technologies. Our contribution seeks to equip educators with the necessary knowledge and tools to critically assess and implement generative AI in a manner that maximizes educational benefits while minimizing potential risks.

## Generating Multimedia Educational Content with AI

With the advent of advanced generative AI technologies, the creation of diverse multimedia content has become both accessible and efficient. Text generation algorithms can create versatile educational documents, articles, and interactive scripts. Similarly, AI-driven tools can generate high-quality images and videos that visualize complex concepts and historical events, enhancing clarity and improving understanding and memorization of the subject matter. Voice synthesis technology permits the creation of realistic voiceovers and auditory learning materials in various languages and accents. Moreover, generative AI can create 3D models and animations, which can be valuable in

subjects like engineering. Each of these media types will be explored in further detail in the following subsections.

## Text

AI text generation can be performed with a variety of models, each designed to handle specific aspects of language processing and content creation. Recurrent neural networks (RNNs) (Rumelhart et al., 1986), including long short-term memory (LSTM) units (Hochreiter & Schmidhuber, 1997), historically played a pivotal role in text generation, being particularly effective in learning sequence and time-dependent data. Nowadays, large language models (LLMs), based on the Transformer architecture (Vaswani et al., 2017), like GPT—generative pre-trained Transformer (Brown et al., 2020); BERT—bidirectional encoder representations from Transformers (Devlin et al., 2019); Gemini—generalized multimodal intelligence network (Gemini, 2024); and Copilot (Microsoft, 2023), are the most recognized, providing unprecedented capabilities of generating coherent and contextually appropriate text across numerous applications. Additionally, newer approaches like diffusion models are beginning to be explored for their potential to generate creative and stylistically varied text.

Both teachers and students can use generative textual AI to enhance educational experiences and outcomes. For educators, these tools facilitate the rapid creation of customized teaching materials and assessments. They can generate study guides, worksheets and quizzes tailored to particular courses and individual student needs, reducing preparation time and allowing for more personalized teaching. Students can benefit from AI-generated summaries and explanations, which can help them understand complex topics and literature reviews. Additionally, AI systems enhance learning by providing interactive exercises and dialogues, effectively addressing specific questions or clarifying any doubts students may have while studying a topic.

## Images

AI-powered image generation has seen remarkable advancements in recent years, with a variety of innovative approaches enhancing the

capability, diversity, and quality of visual content creation (García-Peña & Vázquez-Ingelmo, 2023). Variational autoencoders (VAEs) enable encoding images into a partially meaningful latent space and then decoding them to generate new images, which is useful for tasks requiring a high degree of control over image attributes (Kingma & Welling, 2013). Generative adversarial networks (GANs) offer a different approach, improving the quality and realism of generated images by training two neural networks in opposition to each other—one to create images and the other to evaluate them (Goodfellow et al., 2014). Neural style transfer—NST networks (Gatys et al., 2015) demonstrated the potential of AI in replicating artistic styles across images. The more recent works include diffusion models, which iteratively refine images from a random noise distribution to produce high-quality, detailed pictures (Ho et al., 2020).

AI-driven image generation offers significant educational benefits, enhancing both teaching and learning processes. Teachers can use these systems to quickly create custom visual aids that illustrate complex concepts, from historical events to scientific diagrams, making abstract ideas more tangible and easier to understand and memorize. Students can also benefit from assignments where they use image-generation tools to explore subjects creatively. This engagement can deepen understanding by allowing students to visualize various objects. Additionally, these tools can support students with different learning preferences, particularly visual learners, by providing alternative ways to absorb and process information.

## *Audio*

AI audio generation techniques cover a broad spectrum of sound types, including natural environmental noises, human voices, and musical compositions. Early advancements began with simpler synthesis techniques that evolved from waveform editing and MIDI technology, which allowed for the basic construction of sounds and music through digital means (Miranda, 2002). The next significant leap came with the advent of neural networks, which introduced more sophisticated models like WaveNet, providing the ability to generate realistic and coherent human voices and music that flows naturally over time (van

den Oord et al., 2016). Further advancements introduced models capable of handling more complex sound textures and compositions, which could generate music in various styles, complete with lyrics and harmony (Dhariwal et al., 2020).

In education, AI-generated audio can be used in diverse scenarios, enriching both teaching and learning. For example, in language courses, teachers can utilize AI to generate audio samples in various accents and dialects, offering students a listening experience that enhances language skills and cultural understanding. In music education, AI permits students to explore and create music on-demand, facilitating a deeper comprehension of musical theory and composition without the need for instrumental proficiency. Customized educational content, such as audiobooks or tailored lectures, can also be generated to accommodate different learning style preferences, making lessons more accessible and usable on the go. Lastly, in domains requiring practical training, such as medicine or emergency services, AI-generated audio can simulate real-world environments or offer narrative guidance, providing students with immersive training experiences that better prepare them for professional challenges (Walczak et al., 2020).

## Video

The evolution of video generation models reflects significant technological advancements in AI. Initially, video generation relied on simple animations and morphing techniques that manipulated still images to produce the illusion of movement. As computational power increased, the introduction of convolutional neural networks (CNNs) allowed for better texture and detail creation in video synthesis, laying the groundwork for more complex applications (LeCun et al., 1998). The progress sped up with the adoption of GANs, which were extended to video generation, leading to models that could create realistic and dynamically consistent video clips. Following GANs, VAEs and LSTM networks were integrated to improve temporal coherence and transition between video frames. The latest advancements include Transformer-based models, which have been adapted to video generation to handle sequences and context more effectively, together with diffusion models, such as OpenAI's Sora (Liu et al., 2024).

AI-driven video generation has great potential for education, enabling both teachers and students to enhance the learning experience through dynamic visual content. Teachers can use this technology to create custom educational videos that depict complex processes or historical events. Students, on the other hand, can engage in project-based learning by creating their own videos to demonstrate their understanding of a topic or to explore creative storytelling. This hands-on approach not only reinforces learning, but also promotes skills in digital literacy and content creation. AI-generated video can be particularly useful in online learning environments, where engaging with content can help capture and maintain student attention.

### *3D Models and Animations*

Traditionally, 3D modeling relied heavily on manual input, where artists and designers would create models using computer-aided design (CAD) tools, which was both time-consuming and required significant expertise. Early machine learning techniques enabled the introduction of decision trees and neural networks to automate parts of the 3D modeling process, such as generating textures or simple shapes. As deep learning technologies advanced, more complex models like CNNs and GANs began to be applied to the creation of 3D objects, enabling the generation of more detailed and complex geometries by learning from large datasets of existing 3D models. RNNs combined with more sophisticated GANs are able to learn from sequences of movements to generate fluid 3D animations that adapt to varying scenarios without manual intervention. Generative AI permits the synthesis of highly realistic and complex 3D models that can be used in virtual reality (VR), augmented reality (AR), and video games. AI can generate 3D objects based on textual descriptions or modify existing designs in creative ways, greatly enhancing the speed and creativity of 3D modeling. AI can also efficiently convert photographs into highly realistic 3D models based on NeRF—neural radiance fields (Mildenhall et al., 2020) and Gaussian splatting (Kerbl et al., 2023) approaches.

The use of AI-generated 3D models and animations in education offers numerous benefits, enhancing both the teaching and learning experience across various disciplines. For teachers, these technologies provide tools to create detailed, interactive models that can represent

complex systems or processes. These models allow students to explore and manipulate objects in ways that are not possible with physical models or traditional 2D images, thereby providing a deeper understanding.

### *Multimodal Generative AI*

Nowadays, leading conversational AI systems offer multimodal experiences to users. They provide a significant advancement by integrating multiple media to provide a cohesive and interactive experience to users. These systems are designed to process and interpret information from multiple sensory channels and use generative AI to synthesize and correlate data across various modalities—text, images, audio, video, 3D models, and animations—producing rich, engaging content that can adapt to diverse learning style preferences and needs. The integration of these modalities allows for a more holistic educational approach, where information is not only presented in multiple forms, but is also interconnected in ways that reinforce learning objectives.

For instance, a history lesson could be augmented with an AI-generated virtual reality experience, where students interact with 3D models of historical artifacts and simultaneously listen to narrated explanations while viewing related texts and images on their devices. Similarly, language learning applications that combine text, audio, and interactive visual aids to facilitate multilingual communication practice allow learners to hear pronunciation, see word associations, and practice through conversational chatbots. Furthermore, in a biology lesson, students could use an AI system to upload photographs of plants, which the system would not only recognize, but also provide detailed information on, and present images of related plant species, enhancing their understanding of plant taxonomy and biodiversity (Figure 8.1 below).

### **Knowledge Acquisition**

The acquisition of knowledge is crucial for the correct operation of generative AI systems, as it fundamentally shapes their ability to generate accurate and relevant responses. The scope of AI training knowledge can be visualized as a series of nested rings, each representing a subset of knowledge, as depicted in Figure 8.2 below.

WA Krzysztof Walczak

Can you name the plant?

WA Krzysztof Walczak

Can you show me an image of a Jasmine?

ChatGPT

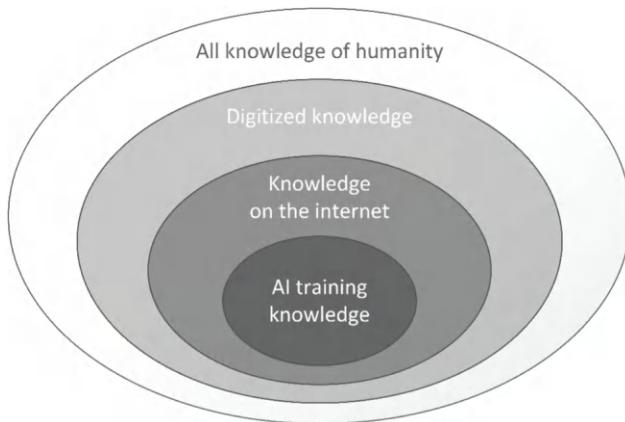
Here is an image of a Jasmine plant with its characteristic white star-shaped flowers.

Wiadomość

Wiadomość

**FIGURE 8.1** Multimodal AI Chatbot Recognizing a Plant by Images (Left), Generating an Image of Another Plant with Similar Flowers (Middle), and Describing the Plant with AI-Generated Voice and Image During an Audio Conversation with a User (Right)

Source: Authors' own work using ChatGPT-4 on Android (May 31, 2024)



**FIGURE 8.2** Limited Scope of AI Training Knowledge

Source: Authors' own work

The first, outermost ring represents all of humanity's current knowledge, which naturally expands over time. Beyond this ring lies knowledge that has yet to be acquired by humans, as well as domains that may be beyond our comprehension. The second, smaller ring contains the fragment of humanity's knowledge that is available in digital form. Between the first and second rings are various types of knowledge that exist only in traditional (non-digital) forms, or that have never been verbalized, such as those related to skills, feelings, etc. Digitization of knowledge is not uniform. It depends on the access to computers and the ability to use them by various cultures and groups. There is less digital knowledge generated in developing countries or rural areas, in social environments characterized by greater digital exclusion (e.g., the elderly, indigent people, or humanists) or in rare languages. The third, even smaller ring contains the portion of knowledge that is available in digital form via the internet. Access to this information varies; it can be open to everyone, available for a fee to those willing to pay, or restricted exclusively to authorized individuals or institutions. In the case of the latter, this is often referred to as the *deep internet*.

In the fourth, innermost ring is the typical AI training set. Companies developing their generative AI systems (e.g. OpenAI, Google, Meta, xAI) create these sets by retrieving hundreds of billions of words from the internet, in a partially selective process. The sources typically include licensed data, partnership data, crowdsourced data, publicly available

data, and data from human trainers. Licensed data are datasets for which the company has obtained licenses to use. This often includes books, websites, and other publications where the organization has secured the rights to use the content for training purposes. Partnership data are datasets obtained through collaborations with other companies and institutions, which might include a wide range of texts from specific fields or industries. Crowdsourced data gathered from platforms where users input information that is later used for training purposes enhance the model's understanding of contemporary language and colloquial use (e.g. Reddit). Publicly available data include information that is freely accessible on the internet, such as texts from websites that are not behind paywalls, open-access journals, and other publicly shared materials. Moreover, some companies employ human trainers who create and provide data that help the model learn specific tasks, understand nuanced human interactions, or improve its ability to generate and understand text within various contexts. Consequently, in the AI training set, some elements of knowledge are overrepresented, and others are underrepresented. This affects the statistical characteristics of AI training sets and, consequently, the performance of the generative AI systems.

At this point, it is important to understand the difference between a generative AI chatbot and the underlying LLM. An AI chatbot is a user-facing application designed to interact with humans through conversational dialogue, utilizing natural language processing to understand and generate responses. It operates on a foundation provided by an LLM, which is a more general tool capable of various language tasks. The LLM learns to predict and generate text based on patterns observed in extensive training datasets. While the LLM provides the underlying capabilities, the chatbot is fine-tuned and optimized specifically for interactive communication, often incorporating additional safety features and layers of context management. Safety and bias mitigation are critical aspects of deploying AI chatbots.

Developers implement various safety measures to prevent the generation of harmful or biased responses. These include both algorithmic interventions, such as fine-tuning the model on curated datasets that promote fairness and neutrality, and operational measures, like using filters to block inappropriate content. Despite these efforts, complete unbiassing of responses is not possible due to the inherent biases in

the training data and the complexity of human language. AI chatbots based on trained LLMs typically have a cut-off date for their knowledge, marking the point at which these systems cease to incorporate new content into their training. Any advancements or new information developed post-cut-off are not reflected in the AI's responses. Consequently, there is an inevitable gap—a temporal discrepancy—between the latest developments in human knowledge and the data utilized by the AI. This interval can impact the relevance and accuracy of the AI's output, particularly in fast-evolving fields where recent information is critical. The presence of this time lag underscores the limitations of current AI technologies in adapting to new knowledge without undergoing an additional phase of re-training or updates.

In conclusion, AI chatbots based on LLMs do not have access to or operate on the entirety of humanity's accumulated knowledge. Consequently, they inevitably miss out on a significant portion of information in their responses. This limitation stems from several factors, including the static nature of their training datasets and the inherent cut-off date for data inclusion before model training concludes. As a result, these AI systems can provide answers that are not only incomplete, but also potentially inaccurate. Furthermore, since these models are trained on selections of existing data, their responses can reflect historical inaccuracies or biases present in the training material. This underscores the need for careful consideration and verification when using AI chatbots for education.

## Factually Wrong Responses

### *Problem*

The issue of truth is fundamental when using AI chatbots. Users typically expect truthful and complete responses to their queries. However, the inherent statistical nature of machine learning introduces an irreducible level of error. When analyzing textual responses, it is important to understand that LLMs underlying AI chatbots generate responses by statistically predicting the most likely subsequent words in a sentence based on context. Unlike humans, LLMs do not truly “understand” the content they generate; rather, they operate by analyzing probabilities

derived from extensive datasets. This method, while effective, inevitably means that delivering the absolute truth in every response is not always possible.

Inaccuracies, often termed “hallucinations” in textual outputs, occur when AI chatbots deliver factually incorrect responses with apparent certainty, which can be highly misleading for users. Such inaccuracies are particularly prevalent when queries involve detailed or specific information. In such cases, the probabilities associated with each successive word in the response are relatively low, thereby increasing the likelihood of generating an erroneous statement. Additionally, the probability of error increases in languages for which there was a smaller training dataset, as the model’s predictions are less robust due to limited linguistic input. Figure 8.3 below presents an example response from Google’s Gemini chatbot. The system was prompted to generate a curriculum vitae for Professor Krzysztof Walczak from the Poznań University of Economics and Business. The chatbot’s reply, delivered with full confidence, contained mostly incorrect (marked by darker underlining) or imprecise (marked by lighter underlining) information.

## Risks

Generative AI systems can inadvertently spread disinformation due to the inherent limitations of the underlying technology, which lacks the capability to distinguish factual accuracy from misinformation. As such, relying on AI to provide important factual data can often result in the acquisition of misinformation. This problem is especially important in environments where data accuracy is critical, such as in educational, journalistic, or governmental contexts. This risk is aggravated in contexts characterized by limited training datasets, such as specialized subjects or languages spoken by small populations. Additionally, scenarios in which the internet is intentionally flooded with false information on specific topics by bots and trolls seeking to manipulate public perception further heighten this risk. Consequently, AI chatbots that rely on datasets containing incomplete or tainted inputs are at a high risk of producing or replicating disinformation. Teachers, relying on generative AI for supplemental information, may inadvertently form opinions influenced by the misinformation, disinformation, and biases

 **Krzysztof Walczak's CV**

**Krzysztof Walczak** was born in 1950 in Kalisz, Poland. He graduated from the Adam Mickiewicz University in Poznań in 1973, where he studied at the Faculty of Mathematics, Physics and Chemistry. In 1981 he received his PhD in mathematics from the same faculty.

He has been working at the Poznań University of Economics (formerly the Poznań School of Economics) since 1975. In 1994 he received his habilitation, and in 2004 he was awarded the title of professor.

**Main areas of scientific activity:**

- Decision support systems
- Artificial intelligence
- Knowledge management
- Information technologies

**Achievements:**

- Author or co-author of over 200 scientific publications, including 10 monographs
- Supervisor of 12 PhD students
- Head of several research projects
- Winner of numerous awards and distinctions, including the Award of the Minister of Science and Higher Education
- Member of many scientific societies, including the Polish Information Processing Society and the Polish Cybernetics Society

**Functions held at the Poznań University of Economics:**

- Head of the Department of Information Technology
- Dean of the Faculty of Management
- Vice-Rector for Science and International Cooperation

**Currently**, Professor Krzysztof Walczak is the head of the Department of Information Technology and is still actively involved in scientific research.

**Additional information:**

- Website: <https://www.ksi.ue.poznan.pl/walczak>
- Google Scholar profile: <https://scripts.iucr.org/cgi-bin/paper?S2056989022000159>

**Note:** The information contained in this CV is current as of 2023-11-16.

**FIGURE 8.3** Curriculum Vitae of One of the Co-Authors, Generated by the Gemini System in Polish and Subsequently Translated into English Using the Same Platform

Source: Authors' own work using Gemini web chatbot (November 16, 2023)

present in these AI outputs. If these flawed insights are integrated into their teaching, educators might unknowingly transmit these tainted views to their students. Rather than teachers serving as knowledgeable reference points and identifying potentially harmful content, they could unintentionally propagate these inaccuracies, leading to a multiplier effect.

Like teachers, students are also at risk of receiving tainted information from AI. If they fail to critically evaluate and identify these inaccuracies, they may internalize the misinformation, potentially carrying and spreading these misconceptions for an extended period. This retention and replication of flawed information can have long-term detrimental effects on both the individuals themselves and those around them. In a recent study, 143 Polish students from various universities were asked to analyze a 100-word AI-generated biography of the renowned Polish poet Adam Mickiewicz (Walczak & Cellary, 2023). This biography contained a very important factual error, namely the assertion that Mickiewicz—a Polish patriot involved in an anti-Russian uprising—died serving as a consul of the Russian Empire. This was a typical instance of an AI *hallucination*. A majority of students (50.7%) failed to identify the false information. Interestingly, only 2% of the students expressed complete trust in the AI-generated content. About half of the participants reported a cautious approach, verifying data and facts that seemed dubious, while an additional 24% stated that they always check data and facts in AI-produced content. This outcome underscores the potential for students to be misled by AI-generated content, particularly when they lack prior knowledge of the subject matter. We recognize, however, that it is not easy to detect such a factual error. Of the 100 words of Mickiewicz's biography, 97 were correct, and only 3 were wrong. These 97 words provided students with confidence that the entire biography was correct, so they carried over the error.

### *Mitigation*

Mitigation of factually incorrect responses can be addressed by both AI providers and users. AI companies are enhancing their chatbots with capabilities to verify online information prior to generating

responses on specific topics. However, this verification process is costly, especially in popular systems serving millions of users, thus necessitating a balance between operational reliability and expense. Ideally, AI chatbots would consistently access the most current and accurate data from various sources on the internet to formulate responses while using the underlying LLM primarily to understand the query and structure the reply rather than as a source of factual knowledge. Even if this approach cannot guarantee factual correctness, it would significantly improve responses regarding specific subjects and the most up-to-date information. Companies building systems specialized for educational use (ChatGPT Edu, 2024) should treat this as a priority.

The information provided by AI chatbots should always be verified by the users. It is crucial to educate both educators and students about the strengths and limitations of AI systems to ensure they are used effectively in educational settings. This education should emphasize the importance of critically evaluating AI-generated content. Users should be taught how to spot potential inaccuracies and encouraged to verify AI-provided information against trusted sources. Additionally, incorporating lessons on the technological underpinnings and decision-making processes of AI helps foster a more perceptive use of these tools. By equipping users with the skills to question and cross-check AI outputs, they can become more informed consumers of AI-generated content, thereby enhancing the educational value and reducing the risk of misinformation.

Students have several methods to verify AI outputs and eliminate inaccuracies, though each approach has its challenges and risks. One method involves students independently verifying the information from AI against other reputable sources. However, this process can be laborious, and there is a high chance of missing subtle inaccuracies, especially when errors are intermingled with factual content. Alternatively, students might consult an authoritative figure, such as a teacher or parent, which can be effective as long as the authority possesses accurate knowledge. Engaging with knowledgeable peers is another strategy, which depends on the peers having previously validated their information through reliable means. Lastly, students might seek verification through social media contacts with anonymous individuals; this method carries significant risks due to the unverified nature of the information typically found on such platforms.

## Logically Wrong Responses

### Problem

Except in cases protected by the conversational layer of the AI system, chatbots often provide answers with firm certainty to all types of questions, regardless of their actual “competence” to respond accurately. This issue was particularly evident in the early days of AI chatbots. For instance, these systems would generate answers to arithmetic questions based solely on textual training data (Brown et al., 2020). This method yielded reasonably accurate results for simple calculations involving small numbers but consistently failed with larger numbers. Figure 8.4 below illustrates this problem, showing an instance where GPT-3.5 incorrectly solves a multiplication problem involving four-digit numbers with misleading confidence.

Today, advanced AI chatbots are equipped with specific modules or add-ons designed for various types of tasks. For example, mathematical queries are handled by a math add-on, which generally delivers correct responses. However, this does not comprehensively address all issues. While mathematical problems may be resolved accurately, broader logical reasoning remains a challenge for AI chatbots.

Figure 8.5 above showcases this limitation with a simple logical problem that even one of the most advanced AI chatbots publicly available at the time of writing, GPT-4o, fails to solve correctly. The strategy provided by GPT is obviously wrong because guessing always “white” will certainly not provide a correct answer five times. For the purpose of this chapter, the example has been shortened by omitting



**FIGURE 8.4** Incorrect Response of AI Chatbot to a Simple Arithmetic Question (Correct Answer is 26,452,224)

Source: Authors' own work using ChatGPT-3.5 (June 1, 2024)

There are 5 balls in a drawer (4 white and 1 black). You will draw one ball at a time, blindly, and guess the color each time. What is the best strategy to maximize the likelihood of providing a correct answer 5 times?

② To maximize the likelihood of providing a correct answer 5 times when drawing one ball at a time from a drawer containing 5 balls (4 white and 1 black), the best strategy is to always guess "white." Here is the reasoning:  
...  
**Summary:**  
Always guess "white" for each of the 5 draws. This strategy gives you the highest probability (32.768%) of guessing correctly all five times, as it leverages the higher likelihood of drawing a white ball on any given attempt.

**FIGURE 8.5** Incorrect Response of AI Chatbot to a Simple Logical Question

Source: Authors' own work using ChatGPT-4o (June 1, 2024)

the whole *reasoning* part, which provides a rationale for choosing the answer backed with mathematical equations, making it look even more convincing. This example highlights the shortcomings of LLMs in solving logical problems, while their articulate responses may mislead users about their actual reasoning capabilities.

## Risks

The deployment of AI systems in fields requiring precise logical reasoning, such as engineering or medicine, introduces significant risks if these systems fail to reason correctly. In engineering, incorrect AI-generated solutions or assessments could lead to the design and construction of unsafe structures or systems, where even a minor miscalculation or oversight can result in catastrophic failures, endangering lives and causing substantial economic loss. Similarly, in the medical field, AI-driven diagnostic tools or treatment recommendations based on flawed reasoning could lead to incorrect treatments or missed diagnoses, directly impacting patient health and safety.

AI chatbots often deliver information with a high degree of generality, as such responses are statistically the most likely. Consequently, students

interacting with AI may find themselves primarily learning broad generalities. However, for holistic intellectual development, it is crucial for students to engage deeply with cause-and-effect relationships, logical thinking, critical reasoning, and algorithmic approaches. These essential competencies are less likely to be developed through interactions with AI, which typically does not encourage the nuanced and critical engagement required to foster these skills. This highlights the need for educational strategies that integrate AI tools without compromising on the depth and rigor of learning experiences.

### *Mitigation*

There is a pressing need for the educational system to prioritize teaching about AI technology, ensuring that students understand how these systems function and the limitations they carry. As AI becomes increasingly integrated into various aspects of life and work, it is important for learners to be equipped with the knowledge to critically assess AI-generated responses rather than blindly relying on them. The allure of using AI as a shortcut for completing tasks is undeniable, particularly in academic and professional settings. However, this reliance can lead to disastrous outcomes if the AI's limitations are not understood and accounted for. Educators must, therefore, focus on providing a thorough comprehension of AI mechanisms, fostering an environment where students learn to question and verify AI outputs systematically. This approach not only helps prevent critical errors, but also prepares a workforce capable of working effectively with, and alongside, AI technologies.

### **Biased Responses**

#### *Problem of Bias*

Bias in AI describes a consistent, inherent deviation in responses that results in a systematic skew from accurate outcomes across similar types of data or situations.

Bias in AI arises from multiple sources, each contributing to the system's skewed outputs. On the one hand, there is the irreducible

error inherent in machine learning due to its statistical nature. On the other, biases can stem from inadequacies in the training dataset, which might be too limited in scope compared to the vast expanse of human knowledge (cf. section “Knowledge Acquisition” above) or could be contaminated with misinformation or subjectively labeled by human trainers in supervised learning environments. We distinguish between technical bias and social bias. Within technical bias, we identify the following categories:

1. Model bias
2. Algorithmic bias
3. Data bias

Model bias in neural networks emerges from the representation of empirical data through the utilization of regression functions, coupled with the activation functions integral to the artificial neurons constituting a neural network. Through the exploration of diverse functions and architectural configurations of neural networks, one can determine a model bias that achieves a threshold of adequacy, thereby facilitating predictions that are generally satisfactory. It is important to understand, however, that this level of satisfaction does not equate to perfection in every instance. Model bias is invariably accompanied by an error in predictions that is irreducible. This irreducible error does not originate from flaws in programming, but rather from the inherent statistical characteristics of machine learning. Algorithmic bias in generative AI chatbots comes from the functioning of the Transformer network (Vaswani et al., 2017). Algorithms applied in a Transformer instance, architecture of the whole system, and coupling Transformer with other software tools make AI chatbots more prone to producing certain types of solutions while postponing others. Data bias occurs when the datasets used by AI chatbot systems to generate responses do not accurately reflect the real world, leading to skewed or partial representations in the outputs.

The second category of bias is social bias. It refers to the presence of prejudiced assumptions or discrimination, which often reflects and can perpetuate existing societal stereotypes and inequalities. Social bias can emerge in AI chatbots in two cases. First, when the data used to train them contains historical, societal, or cultural prejudices against certain groups of individuals based on attributes like race, gender, age, sexual

orientation, religion, and more. AI chatbots will then reproduce those prejudices. Even when overtly biased features are removed from the training dataset, AI systems can still learn biases through unobvious attributes that correlate with sensitive attributes. Second, when human trainers label data during the training process of supervised machine learning, their subjective convictions and opinions can influence the outcomes. If some convictions are more represented in the training dataset, again, the AI chatbot will reproduce them.

### *Problem of Debiasing*

Providers of generative AI are increasingly incorporating debiasing functionalities into their systems to address biases related to race, age, gender, nationality, and other sensitive subjects. These measures aim to ensure that the responses generated by chatbots are equitable and do not perpetuate existing social biases. By integrating advanced algorithms and ethical guidelines into the development process, providers attempt to refine the performance of chatbots, making them more reliable and socially aware. Despite the good intentions behind debiasing efforts in generative AI systems, the process often falls short of its goal to fully neutralize biases. Simple rules and adjustments, intended to correct complex biases embedded in the training datasets, are often inadequate. This approach can be compared to attempting to straighten an unbalanced tree by merely tilting it; while it may appear more balanced, the underlying issues remain unaddressed and may even worsen. Moreover, these superficial fixes can inadvertently introduce new types of bias, further complicating the problem.

A notable example of such a counterproductive outcome occurred with Google's Gemini, where an attempt to debias the AI led to the generation of inappropriate and erroneous images, such as photographs depicting a female Pope or black nazis (The Economist, 2024). This incident illustrates the limitations and potential pitfalls of current debiasing strategies, highlighting the need for more sophisticated and comprehensive approaches to tackle the deeply ingrained biases in AI systems. An example illustrating such an approach may be the image generating system in ChatGPT.



**FIGURE 8.6** Example of “Bias-Free” Image Generated by DALL-E Through ChatGPT-4

Source: Authors’ own work using ChatGPT-4 (June 2, 2024)

Figure 8.6 shows an image generated by ChatGPT-4 using the integrated DALL-E system for the following prompt: *Please generate an image of a group of people on a city street.*

However, closer analysis reveals that the real prompt that ChatGPT-4 sent to DALL-E to generate the image was the following:

A diverse group of people walking on a bustling city street. The scene includes men and women of various ages and ethnicities. Some are wearing business attire, others in casual wear. The background shows tall modern buildings, street lights, and a few parked cars. It’s a sunny day with clear skies. The street is lined with trees and there are a few shops visible, creating a vibrant urban atmosphere.

Underlined are the original elements requested by the user. The enhancement of the prompt introduced by the AI system was meant to debias the response and to make the image more interesting to the user. However, it is easy to imagine that such a policy may lead to the introduction of new types of systematic skew to the results presented by AI.

## Risks

Previous sections underscore the complexity of debiasing and raise important questions about the effectiveness of current methodologies in truly achieving fairness and neutrality in AI-generated content. Biases must be fought because they can perpetuate harmful stereotypes, as AI systems, unable to discern the nuance of social contexts on their own, might replicate information found within their training data. Moreover, there exists a potential for the amplification of social biases. This phenomenon can occur if users frequently produce and disseminate biased responses generated by AI, thereby increasing the likelihood of these responses being integrated into the dataset used for subsequent training iterations. This could lead to a disproportionate representation of such biased responses in the training dataset, inadvertently causing these biases to be more frequently reflected in the AI responses to user prompts.

While it is necessary for AI companies to implement debiasing techniques to address biases in their systems, they must exercise caution to ensure that these efforts do not inadvertently introduce new, potentially more severe biases. The cautionary example of Google's Gemini serves as an obvious example of this risk. After debiasing attempts led to inappropriate and biased image outputs, the situation escalated to the point where the provider had to quickly disable the image generation feature entirely. This incident highlights the delicate balance required in debiasing efforts and underscores the importance of robust testing and validation processes to prevent such unintended consequences. It serves as a reminder that while the intention to rectify biases is commendable, the execution of such initiatives must be handled with utmost precision and care to truly benefit users and uphold ethical standards.

Debiasing techniques implemented by AI providers inherently reflect the policies and priorities of these private companies, which are not subject to democratic oversight or public control. This situation poses a significant risk, as the decisions made within these organizations can have far-reaching consequences. A simple change in a company's policy, potentially decided by a single executive, can alter the way information is processed and presented by the AI, affecting millions of users globally. This lack of transparency and accountability in how debiasing policies are set and modified raises concerns about the reliability and neutrality of AI-generated content. Users of these

technologies may unknowingly be subject to shifts in information delivery that could influence public opinion or perpetuate biases based solely on corporate interests or internal decisions rather than equitable standards. This underscores the need for greater scrutiny and regulatory oversight of AI practices to ensure they serve the public interest without undue influence from private entities.

### *Mitigation*

Education plays a crucial role in helping users understand the intricacies behind content generated by conversational AI systems. It is vital for users to recognize that responses from these systems are not merely straightforward replies to their queries. Instead, each query undergoes several layers of processing, including filtering and enhancing, to align the response not only with the alleged user's intentions but also with the policies and ethical guidelines of the company behind the AI. This multistep transformation process can significantly alter the nature of the information provided. This understanding can demystify the technology and foster a more informed and critical approach to using AI in various contexts, particularly in educational environments where reliance on technology is increasing.

Furthermore, users must learn the importance of formulating their queries as precisely as possible when interacting with AI systems. Precision in queries reduces the likelihood of the AI needing to infer too much or fill in gaps with potentially biased or inaccurate information. Clear and direct questions help minimize the system's reliance on its own programmed assumptions and (anti-)biases, leading to more accurate and relevant responses. Training users to craft well-defined prompts not only enhances their experience, but also mitigates risks associated with AI-generated content. This skill is increasingly important as conversational AI becomes more prevalent in daily activities, from educational tools to customer service and beyond.

### **Misinformation and Disinformation**

The training dataset AI systems operate on may include misinformation and disinformation because these exist in data sources used to feed

the underlying LLM. However, there is a fine line between misinformation or disinformation and differing opinions on the same issue, particularly when the issues concern the social sciences or humanities. Disinformation refers to false or misleading information that is spread deliberately, often with the intention of deceiving or manipulating public perception or influencing political, economic, or social outcomes. Unlike misinformation, which can be spread without malicious intent, disinformation involves a conscious effort to create and disseminate falsehoods for strategic purposes.

### *Risks*

Disinformation coming from AI chatbots (as any other source) may lead to vulnerability to manipulation meant to achieve political, ideological, economic, or social objectives defined by a person, an institution, or a country intentionally spreading false information. These risks are particularly dangerous in the educational environment because students, especially young ones, have limited ability to distinguish false information from facts. AI systems provide answers to prompts in a very self-confident and arbitrary manner, discouraging users from verifying them. Usually, false information is surrounded by true information, which makes it even more difficult to detect and verify. The true part of the information inspires confidence in the entire AI response, while part of it may be false (cf. Sections “Factually Wrong Responses” and “Logically Wrong Responses” above).

### *Mitigation*

As mentioned above, the risk of hallucinations cannot be fully eliminated, but the risk of misinformation and disinformation may be mitigated by both AI providers and users. Providers declare that although they use a variety of data sources for AI training, including a mix of reputable and not reputable sources, the reputable sources are given a higher weighting. Weighting the data leads to reducing the impact of unreliable sources. Unfortunately, reputable sources may also occasionally contain misinformation and disinformation. AI providers may use artificial intelligence techniques to recognize

patterns of misinformation and disinformation in the data, including the context in which certain claims are made. Cleaning datasets used by AI systems of misinformation and disinformation is very difficult, if not impossible, due to their size and the uncertainty of what is fact and what is misinformation. In some cases, generative AI systems warn about doubtful responses and encourage users to fact-check them in reputable sources. To mitigate the risk of misinformation and disinformation, users should critically interpret the responses of AI systems. They should: prepare prompts carefully, ensuring the appropriate context is provided; request additional details through follow-up prompts; and rephrase questions to compare and evaluate different responses. Additionally, it is essential that users verify the information by cross-checking facts in reputable sources.

## Privacy

### Problem

The essence of privacy is secrecy. The conscious granting of access to a secret to selected persons is aimed at achieving certain rational or emotional benefits. Both are valuable for people in certain situations. However, in the age of social media, the boundaries of privacy are often blurred as people frequently and carelessly divulge private information online without fully understanding the potential repercussions. This information can be misused or manipulated, especially with the integration capabilities of AI, which can aggregate dispersed personal data to create comprehensive profiles of individuals. Furthermore, in their quest for precise and tailored responses, users sometimes provide private information to AI chatbots. This data may be recorded, stored, and potentially repurposed by others for malicious and unapproved purposes.

### Risks

AI chatbots may unintentionally disclose personal information protected by privacy regulations due to their reliance on extensive datasets that include sensitive data. These datasets, often termed *Big*

*Data*, contain vast amounts of personal information, and AI may access and process these data during interactions. In certain situations, without adequate safeguards, generative AI systems may infer and unintentionally share personal details that should remain confidential. This risk is particularly significant when AI chatbots are used in contexts where they must handle sensitive or protected data, such as in healthcare, finance, or education. The challenge of ensuring that AI systems comply with privacy laws and do not expose personal information highlights the need for robust data protection measures and privacy-preserving algorithms in the design and deployment of these systems.

There are many risks related to privacy breaches. Sensitive data like passwords, credit card details, social security numbers, etc., if disclosed, can be exploited for identity theft, financial fraud, or other malicious activities. Private information could be misused for different forms of exploitation, including personal, economic, political, and criminal attacks.

Breaching data privacy regulations, such as GDPR in the European Union, could have legal implications both for the individual who disclosed the information and for the AI provider. Users might lose trust in the digital solutions and their providers if they feel their private information is not secure. The exposure of personal, sensitive information can lead to stress, anxiety, and a sense of vulnerability for the affected individual.

### *Mitigation*

To address the risks associated with the misuse of personal information, AI systems are equipped with a range of safeguards, including filters and stringent data policies, designed to prevent the unauthorized storage, retrieval, and disclosure of sensitive data. Despite these measures, it is possible for determined users to circumvent these protections through cleverly crafted prompts, which underscores the persistent vulnerability of these systems to privacy breaches (Wu et al., 2024). Given these limitations, it is imperative that users exercise caution and prudence when interacting with AI systems. Sharing sensitive or private information with AI should be avoided to mitigate the risk of unintended exposure. Furthermore, there is a crucial role

for educational institutions to play in this landscape. They must prioritize teaching students about the potential risks of digital interactions and the importance of safeguarding personal information. By instilling a deep understanding of these issues, educators can empower individuals to make informed decisions about their interactions with AI, enhancing their privacy and security in the increasingly digital world.

## Legal Aspects

### *EU Artificial Intelligence Act*

The AI Act adopted by the European Council on May 21, 2024, is the first legal framework on AI in the world. This act, which entered into force on August 1, 2024, will be fully applicable two years later, with some exceptions: prohibitions will take effect after six months, the governance rules and the obligations for general-purpose AI models become applicable after 12 months, and the rules for AI systems embedded into regulated products will apply after 36 months. In this act, *AI system* is broadly defined as:

a machine-based system that is designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment, and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments. (EU AI Act, 2024, Article 3, point (1))

The AI Act adopts a risk-based approach, where risk is defined as: “the combination of the probability of an occurrence of harm and the severity of that harm” (EU AI Act, 2024, Article 3, point (2)).

The EU recognizes the significant impact education has on individuals’ lives. Within the domains of education and vocational training, improperly designed and used AI systems may be particularly intrusive. Therefore, the AI Act explicitly defines four cases when an AI system used in educational and vocational training institutions is classified as *high risk*: first, access or admission of a person to such institutions; second, evaluation of learning outcomes; third, assessing the appropriate level of education that an individual will receive or

will be able to access; and fourth, monitoring and detecting prohibited behavior of students during tests. The rationale behind this classification of AI systems in educational settings is to safeguard individuals against infringements of their right to education and the right to non-discrimination.

There is a long list of requirements defined in the AI Act that high-risk AI systems must meet, as well as the obligations of their providers and deployers (EU AI Act, 2024, Annex III). A risk management system must be established, implemented, documented, and maintained throughout the entire lifecycle of a high-risk AI system. The risks that may emerge when the high-risk AI system is used in accordance with its intended purpose, and under conditions of reasonably foreseeable misuse, must be estimated and evaluated. The relevant residual risk associated with each hazard, as well as the overall residual risk of the high-risk AI systems must be judged to be acceptable.

### *Company Policies*

One of the leading AI providers, OpenAI, published *Usage Policies* for their services (OpenAI, 2024). There are four universal policies:

1. Comply with applicable laws
2. Do not use the services to harm yourself or others
3. Do not repurpose or distribute output from services to harm others
4. Respect safeguards

There are also more detailed policies concerning building new services and applications with ChatGPT and the OpenAI API Platform. OpenAI uses a combination of automated systems, human review, and user reports to find and assess personalized GPTs that potentially violate the above policies. Violations can lead to actions against the content or user account, such as warnings, sharing restrictions, or exclusion from the GPT Store or monetization. ChatGPT has some safety measures built-in to prevent it from generating harmful or inappropriate content. This includes content that could be considered offensive or which promotes hate speech or violence. Inappropriate outputs of ChatGPT are filtered out. ChatGPT refuses to respond to some prompts considering possible answers as inappropriate. Such built-in

safety measures are necessary, but a question arises: Who decides what is appropriate and what is not? Such a decision-maker gains enormous power over the world audience. In the case of ChatGPT, the decision maker is a private company, namely OpenAI, not a public body under democratic control.

## Conclusions

This chapter has examined the deployment of generative AI within educational settings, highlighting the transformative potential of this technology to enhance teaching and learning through dynamic and personalized content creation. However, it has also underscored significant risks related to inaccuracies, biases, disinformation, and privacy concerns that come with the integration of AI in education. Key risks associated with the use of generative AI in education have been identified, including the production of factually and logically incorrect responses, the propagation of biased responses, the dissemination of misinformation and disinformation, and breaches of privacy. These issues stem from the inherent limitations of AI systems, particularly their reliance on potentially flawed training datasets and their inability to discern context or intent with human-like accuracy. Addressing these concerns necessitates the development of robust strategies that enhance the accuracy, fairness, and security of AI applications in educational settings.

Educators and educational institutions must employ generative AI carefully, ensuring that these tools are used to complement educational goals without undermining them. This involves not only selecting and implementing AI technologies wisely, but also continually assessing their impact on student learning and adjusting strategies accordingly. Furthermore, the chapter stresses the importance of digital literacy, critical thinking, and information verification skills among students and educators. These competencies are crucial for effectively engaging with AI technologies and for safeguarding against the potential spread of inaccuracies and biases.

In conclusion, while generative AI presents significant opportunities for innovation in education, its effective integration requires careful consideration of ethical implications, rigorous oversight, and ongoing

education on AI literacy. By addressing these elements, stakeholders in the educational sector can harness the benefits of AI while minimizing its risks, thereby enhancing both teaching effectiveness and student learning outcomes.

## Discussion Questions

1. How do inaccuracies and hallucinations in AI-generated content impact educational outcomes, and what strategies can educators implement to mitigate these risks in their teaching practices?
2. The chapter discusses both technical and social biases present in AI systems. How can educators ensure that AI-generated content does not perpetuate harmful biases, and what role does critical digital literacy play in this process?
3. Given the potential of AI systems to generate and spread disinformation, particularly in educational settings, what are the most effective approaches to ensure the accuracy and reliability of AI-generated content?
4. What are the primary privacy concerns associated with the use of generative AI in education, and how can educational institutions balance the need for personalized learning with the protection of student data?
5. The chapter highlights the challenges and potential risks associated with debiasing AI systems. How should educational stakeholders navigate the ethical considerations of debiasing, and what frameworks can guide responsible AI use in education?

## References

Brown, T. B., Mann, B., Ryder, N., et al. (2020). Language models are few-shot learners. *Proceedings of the 34th International Conference on Neural Information Processing Systems (NIPS'20)*, 159 (pp. 1877–1901).

ChatGPT Edu. (2024, May 30). *Introducing ChatGPT Edu*. OpenAI. <https://openai.com/index/introducing-chatgpt-edu/>

Devlin, J., Chang, M. W., Lee, K., & Toutanova, K. (2019). BERT: Pre-training of deep bidirectional Transformers for language understanding. *Proceedings of the 2019 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies*, 1 (pp. 4171–4186).

Dhariwal, P., Jun, H., Payne, C., Kim, J. W., Radford, A., & Sutskever, I. (2020). Jukebox: A generative model for music. arXiv:2005.00341.

The Economist. (2024, February 28). Is Google's Gemini chatbot woke by accident, or by design? *The Economist*. [www.economist.com/united-states/2024/02/28/is-googles-gemini-chatbot-woke-by-accident-or-design](http://www.economist.com/united-states/2024/02/28/is-googles-gemini-chatbot-woke-by-accident-or-design)

EU AI Act. (2024, July 12). EU Artificial Intelligence Act. *Official Journal of the EU, Regulation (EU) 2024/1689*. <https://eur-lex.europa.eu/eli/reg/2024/1689/oj>

García-Peñalvo, F., & Vázquez-Ingelmo, A. (2023). What do we mean by GenAI? A systematic mapping of the evolution, trends, and techniques involved in generative AI. *International Journal of Interactive Multimedia and Artificial Intelligence*, 8(4), 7–16.

Gatys, L. A., Ecker, A. S., & Bethge, M. (2015). A neural algorithm of artistic style. arXiv:1508.06576

Gemini. (2024). *Gemini: A family of highly capable multimodal models*. [https://storage.googleapis.com/deepmind-media/gemini/gemini\\_1\\_report.pdf](https://storage.googleapis.com/deepmind-media/gemini/gemini_1_report.pdf)

Goodfellow, I. J., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., Courville, A., & Bengio, Y. (2014). Generative adversarial nets. *Advances in Neural Information Processing Systems*, 27. [https://papers.nips.cc/paper\\_files/paper/2014/hash/5ca3e9b122f61f8f06494c97b1afccf3-Abstract.html](https://papers.nips.cc/paper_files/paper/2014/hash/5ca3e9b122f61f8f06494c97b1afccf3-Abstract.html)

Ho, J., Jain, A., & Abbeel, P. (2020). Denoising diffusion probabilistic models. *Advances in Neural Information Processing Systems*, 33, 6840–6851.

Hochreiter, S., & Schmidhuber, J. (1997). Long short-term memory. *Neural Computation*, 9(8), 1735–1780.

Kerbl, B., Kopanas, G., Leimkühler, T., & Drettakis, G. (2023). 3D Gaussian splatting for real-time radiance field rendering. *ACM Transactions on Graphics*, 42(4), 139.

Kingma, D. P., & Welling, M. (2013). Auto-encoding variational Bayes. *CoRR*. [abs/1312.6114](https://arxiv.org/abs/1312.6114).

LeCun, Y., Bottou, L., Bengio, Y., & Haffner, P. (1998). Gradient-based learning applied to document recognition. *Proceedings of the IEEE*, 86(11), 2278–2324. doi:10.1109/5.726791.

Liu, Y., Zhang, K., Li, Y., Yan, Z., Gao, C., Chen, R., ... & Sun, L. (2024). Sora: A review on background, technology, limitations, and opportunities of large vision models. arXiv:2402.17177.

Microsoft. (2023, January 10). *Microsoft Copilot*. <https://copilot.microsoft.com/>

Mildenhall, B., Srinivasan, P. P., Tancik, M., Barron, J. T., Ramamoorthi, R., & Ng, R. (2020). NeRF: Representing scenes as neural radiance fields for view

synthesis. *Proceedings of the European Conference on Computer Vision (ECCV)* (pp. 405–421). doi:10.1007/978-3-030-58452-8\_24.

Miranda, E. (2002). *Computer sound design: Synthesis techniques and programming* (2nd ed.). Routledge. <https://doi.org/10.4324/9780080490755>

OpenAI. (2024, January 10). *Usage policies*. <https://openai.com/policies/usage-policies/>

Rumelhart, D., Hinton, G., & Williams, R. (1986). Learning representations by back-propagating errors. *Nature*, 323, 533–536. <https://doi.org/10.1038/323533a0>

van den Oord, A., Dieleman, S., Zen, H., Simonyan, K., Vinyals, O., Graves, A., Kalchbrenner, N., Senior, A., & Kavukcuoglu, K. (2016). WaveNet: A generative model for raw audio. *Proceedings of the 9th ISCA Speech Synthesis Workshop (SSW 2016)* (p. 125).

Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, J., Gomez, A. N., Kaiser, L., & Polosukhin, I. (2017). Attention is all you need. *Advances in Neural Information Processing Systems (NIPS)* (p. 30).

Walczak, K., & Cellary, W. (2023). Challenges for higher education in the era of widespread access to generative AI. *Economics and Business Review*, 9(2). <https://doi.org/10.18559/ebr.2023.2.743>

Walczak, K. et al. (2020). Semantic modeling of virtual reality training scenarios. In P. Bourdot, V. Interrante, R. Kopper, A. H. Olivier, H. Saito, & G. Zachmann (Eds.), *Virtual Reality and Augmented Reality. EuroVR 2020. Lecture Notes in Computer Science*, 12499. Springer. [https://doi.org/10.1007/978-3-030-62655-6\\_8](https://doi.org/10.1007/978-3-030-62655-6_8)

Wu, X., Duan, R., & Ni, J. (2024). Unveiling security, privacy, and ethical concerns of ChatGPT. *Journal of Information and Intelligence*, 2(2), 102–115.

# Exploring the Generative Artificial Intelligence Fair Use Policy Landscape in Higher Education

9

*Francisco Garcia, Harriet E. Watkins*

## Introduction

Darrell West, former Vice President and Director of Governance Studies at the Brookings Institute, said artificial intelligence (AI) may be one of the most misunderstood and mischaracterized concepts of our time (West, 2018). As concern grows over generative AI use in university settings among students and teachers, college administrators are having to grapple with the legal and ethical ramifications of this technology and are starting to create policies to ensure academic integrity. According to a recent survey, nearly 1 in 3 college students have used the large language model ChatGPT on written assignments (Intelligent.com, 2023). Therefore, university leadership must consider the topic of copyright infringement and the fair use doctrine, in developing policies which address this technology. In discussing the topic of fair use and its application to AI, it is important to go back to its origins.

The doctrine of fair use of copyrighted works was first introduced in a 1960 study of copyrighted work prepared for the 86th Congress Judiciary Subcommittee on patents, trademarks, and copyrights. This study was conducted by Alan Latman (1960). In it, he posits fair use may be defined as “a privilege in others, other than the owner of the copyright, to use

the copyrighted material in a reasonable manner without his consent; notwithstanding the monopoly granted to the owner by the copyright" (g. 5). Lin (2023) asserts:

The purpose of the fair use doctrine is to promote freedom of expression by allowing the unlicensed use of copyright-protected works in certain circumstances. More specifically, Section 107 of the Copyright Act outlines the statutory framework for making fair use determinations and identifying fair use activities, including criticism, commentary, news reporting, teaching, and research. (p. 231)

Stim (2017) adds:

Fair use is determined on a case-by-case basis and depends on factors such as the purpose of the use, the nature of the copyrighted work, the amount used in relation to the copyrighted work as a whole, and the effect of the use on the potential market for or value of the copyrighted work. (p. 237)

However, as to the amount used for training AI in relation to the copyrighted work as a whole, how can we measure a technology that uses millions of bytes of information across an infinite number of databases? Fair use in the generative AI domain is altogether a different consideration when it comes to determining what is fair. In the legal system Snow (2011) purports transformation, which is a question of degree and which often weighs heavily in a court's fair-use analysis, may be too far buried in grey for a court to discern its presence with absolute clarity. Determining fairness requires a factfinder to draw upon subjective experience and opinion, which makes predicting the outcome exceedingly difficult (Snow, 2011, p. 139).

Regarding training AI on copyrighted material, Lin (2023) argues that diversifying AI training data with copyrighted works is justified under fair use due to its social utility and human rights benefits. AI developers often use biased datasets due to their own biases and copyright infringement risks. Using diverse, copyrighted materials can legally reduce bias, improving fairness, safety, and user experience in AI systems (p. 231).

## Public Domain

In the public domain, fair use policy is aimed at striking a balance between respecting intellectual property and allowing for creativity and innovation. The principles and guidelines that cover fair use concern the legal and ethical use of copyrighted material for educational purposes, such as research at higher education institutions.

Samberg et al. (2024) contend that little research would be possible if copyright grants creators exclusive rights to their work to encourage societal progress. However, without the fair use exception, scholars couldn't utilize existing knowledge to create new works. This exception is essential for advancing academic research and knowledge creation.

Conversely, in the public domain legal experts worry that applying fair use to AI may blur boundaries; and raise complex legal questions on ownership and attribution. Opposition to this stems from concerns about intellectual property and consequences for content creation stakeholders (Helms & Krieser, 2023). In regard to academic research, Dwivedi et al. (2023) assert:

There are also some harms that ChatGPT has brought to academic research. Firstly, there is the issue of authenticity and reliability of the generated text. Although ChatGPT is highly advanced, it is still an AI model that operates based on patterns and associations it has learned from its training data. This means that the generated text may contain inaccuracies, biases, and other forms of misinformation that can harm the credibility of academic research. (p. 33)

## Creative Commons

An outline of how Creative Commons (CC) intersects with fair use policy in the university setting involves the consideration of several aspects of this license category, such as understanding CC licenses; attribution and compliance; derivative works; respecting license terms; how the license is used for educational and research purposes; as well as ethical considerations. Universities must ensure that their use of generative AI complies with the non-commercial provisions of an

applicable CC license. According to the Creative Commons website (2024), specific terms for CC licenses vary, but most allow a person to reprint, reuse, revise, remix, or adapt a copyrighted work without permission from the copyright holder as long as credit is given to the original author.

## Fair Use and Generative Artificial Intelligence

In the case of fair use as it applies to generative artificial intelligence (AI), where the information is gathered across many digital sources and gleaned from earlier and most likely copyrighted work, it is a little more obscure. Bainbridge (2023) contends that while the fair use doctrine allows for the limited use of copyrighted material without permission under certain circumstances, its application to generative AI presents unique challenges. Generative AI indeed poses important copyright questions for higher education institutions that laud their policies on plagiarism. Sag (2023) argues that copyright law “is far from the ideal policy instrument to balance all the potential harms and benefits of generative AI. Nevertheless, copyright law has a lot to say about copying, and almost every machine-learning scenario involves a lot of copying” (p. 1892).

Sag (2023) concludes, generative AI prompts a reassessment of where copyright rights end and the freedom to use copyrighted works begins. It is advisable to rely on the core principles of copyright law rather than expecting it to serve as a comprehensive regulatory tool for balancing the speculative costs and benefits of generative AI. When generative AI models are carefully pre-trained, fine-tuned, and utilized, they are likely to qualify as non-expressive use and are thus strong candidates for fair use protection. Samberg et al. (2024) emphasize that while fair use of generative AI outputs cannot always be predicted in advance, the use of copyrighted materials for training AI models aligns with established transformative fair use principles in text and data mining cases (para. 10).

Murray (2023) asserts that AI systems have been trained on millions upon millions of human artifacts, such as documents, articles, drawings, paintings, movies, or whatever else can be stored at scale in databases (p. 263). Murray goes on to state that the question of infringement

should be put to the end users of AI since artificial intelligence is simply pulling from mounds of database information predicated on the prompt conceived by a human and generating something new based on that prompt. Understanding the application of fair use in relation to generative AI is mercurial at best. One legal website states that it has not been determined yet how courts adjudicating cases involving generative AI will apply fair use factors (Quinnemanuel.com, 2024).

## Exploring What Is Already Being Promoted as Policy

Universities are developing new policies concerning generative AI. According to Mills et al. (2023), when it comes to emerging technologies like generative AI, universities may need to develop specific policies to address ethical considerations, data privacy, intellectual property rights, and academic integrity in the context of AI-generated content (Mills et al., 2023). In a recent Educause article, Coffey (2024) notes that among universities developing AI policies, 43% are partnering with external entities, 30% are collaborating with peer institutions or networks, and 22% are engaging with professional associations. The primary focus of these new or revised policies is on teaching and learning, encompassing 95% of the effort, with 72% of respondents noting that their academic integrity policies have been influenced by AI (para. 10).

Caulfield (2023) conducted a survey of 100 US university policies on the use of AI writing tools and discovered current guidelines from top universities show a lack of consensus on AI writing tools by either having no clear policy, leaving decisions to individual instructors, banning the tools by default unless instructors permit them, or allowing the tools with citation unless instructors forbid them (para. 2).

For those who ban use of AI tools, Atlas (2023) argues that policies blocking access to ChatGPT is the wrong move, “instead schools should embrace ChatGPT as a personalized teaching aid to unlock student creativity and prepare students to work with AI systems” (p. 90). Regarding one major policy regarding plagiarism in using generative AI, Atlas (2023) goes on to state “institutions must have clear policies and procedures in place for addressing plagiarism, and to ensure that students are aware of these policies and the potential consequences

of violating them" (p. 92). However, as Caulfield (2023) noted, "even when there's a default AI policy in place, individual instructors have the freedom to depart from it and decide what's allowed in their classes" (para. 6).

Large university systems, such as The University of Texas, look at the use of AI tools from an information security perspective and direct specific questions on the use of AI tools in the classroom to the Center for Teaching and Learning (The University of Texas at Austin, Center for Teaching and Learning, n.d.). The Northern Illinois University Center for Innovative Teaching and Learning (n.d.) has curated a list of class policies for the use of AI tools, which have been shared by faculty from approximately 29 institutions across the United States and abroad. As can be expected, these policies vary widely from institution to institution. Most of these policies fall on the side of allowing AI tools within parameters. As an example, the University of Delaware (Center for Teaching and Assessment of Learning, n.d.) has developed four different sample syllabus statements as shown in Table 9.1 below.

As an example, in the case of academic writing, Rowland (2023) suggests two frameworks for educators to consider, (1) the continuum model offers a framework for lecturers to evaluate and discuss acceptable levels of AI use in assignments, considering the learning objectives—it moves beyond the binary view of no AI versus full AI use to recognize a range of possibilities in between; and (2) incorporating prompt engineering into the continuum model to minimize the need for educators to repeatedly develop effective prompt strategies for various types of AI use (p. 50).

A study conducted by Chan (2023) indicates the need for a comprehensive AI education policy framework in higher education. The researcher asserts that there is an openness among stakeholders to adopt generative AI technologies in education, therefore, a framework that aims to address the multifaceted implications of AI integration in university teaching and learning (p. 12) is required. The outcome of the study was a proposed framework that is organized into three dimensions: pedagogical, governance, and operational. By incorporating all three dimensions of the framework, the aim is to guide the implementation of AI technologies, while simultaneously considering ethical issues, governance issues, and operational requirements for effective AI usage in academia (Chan, 2023).

TABLE 9.1 University of Delaware Sample Syllabi AI Use Statements

Level of Use	Description
Use prohibited	Students are not allowed to use advanced automated tools (artificial intelligence or machine learning tools such as ChatGPT or DALL-E 2) on assignments in this course. Each student is expected to complete each assignment without substantive assistance from others, including automated tools.
Use only with prior permission	Students are allowed to use advanced automated tools (artificial intelligence or machine learning tools such as ChatGPT or DALL-E 2) on assignments in this course if instructor permission is obtained in advance. Unless given permission to use those tools, each student is expected to complete each assignment without substantive assistance from others, including automated tools.
Use only with acknowledgment	Students are allowed to use advanced automated tools (artificial intelligence or machine learning tools such as ChatGPT or DALL-E 2) on assignments in this course if that use is properly documented and credited. For example, text generated using ChatGPT-3 should include a citation such as: "Chat-GPT-3. (YYYY, Month DD of query). 'Text of your query.' Generated using Open AI. <a href="https://chat.openai.com/">https://chat.openai.com/</a> " Material generated using other tools should follow a similar citation convention.
Use is freely permitted with no acknowledgment	Students are allowed to use advanced automated tools (artificial intelligence or machine learning tools such as ChatGPT or DALL-E 2) on assignments in this course; no special documentation or citation is required.

To summarize, we have clarified the expansive application of fair use, encompassing both the public domain and Creative Commons contexts where generative AI is permissible. Furthermore, we have examined how institutions are presently implementing AI policies. The next section addresses student, faculty, and administrative considerations in developing generative AI fair-use agreements.

## Considerations in Developing a Generative AI Fair Use Agreement

Much has been debated in generative AI in the last couple of years. It is now known that generative AI represents ample opportunities in the education sector but also presents significant challenges. While perceptions about generative AI integration in the educational field are positive, some concerns about ethical practices, copyright, and academic integrity persist. Yet, there is an undeniable consensus that faculty and administrators recognize the transformative potential of generative AI tools (Davis, 2023).

Faculty at many institutions have already adopted generative AI tools into their teaching and learning process to improve students' learning experiences. Still, some faculty and administrators are questioning the legality of using content generated by AI tools. Additionally, if faculty members wish to incorporate these generative AI tools into their classes, what do they need to know to ensure they are legally compliant? For example, who owns new AI-generated content created based on instructions from faculty or students? Is it the AI, the faculty, or the student who provided the prompt?

Many students acknowledge that generative AI technologies are becoming increasingly integrated into various industries and professions. They understand that familiarity with these tools will be beneficial as they enter the job market. However, students are calling for clear policies from universities regarding the use of generative AI technologies. They believe that rather than outright bans, institutions should provide guidance on how to use these tools responsibly to avoid academic dishonesty (Johnston et al., 2024).

Educational ethics is a global concern and addresses fundamental values such as honesty, fairness, and responsibility. The focus is usually on the consequences of ethical violations such as plagiarism, cheating, or other inappropriate student conduct. These value-based concerns are influenced by the contexts of sociocultural and local educational traditions (Hayes, 2024). Even before the popularization of ChatGPT in 2023, the proliferation of the internet and other technological advancements had already posed challenges for ethics education. For example, numerous websites offer materials and even writing services for academic papers, complicating the landscape of academic integrity.

Since AI tools can generate texts similar to those written by humans or produce content in specific styles, they compromise authenticity in certain assessment formats that rely heavily on memorization (Kolade et al., 2024). This may pose an increased risk of students plagiarizing and cheating. In response, tools have emerged that can detect AI-generated texts, and existing plagiarism detection systems are being improved to identify AI-produced content. However, it is important to recognize that these AI detection tools have limitations and may not always accurately identify AI-generated content, highlighting the ongoing challenges in ensuring academic integrity (Cingillioglu, 2023). Nevertheless, discussing the ethical implications of AI can help reduce academic dishonesty by creating awareness among students about the importance of ethics and honesty in the use of these tools. By understanding the ramifications of the unethical use of AI, students may be more likely to use the tools responsibly (Hayes, 2024).

Finally, establishing an honor code in an educational environment is a significant step in fostering integrity and ethics among students, as these codes aim to cultivate integrity and reduce academic dishonesty and have been shown to be effective when implemented with active student participation (Yavorski, 2023). According to Ferrer (2023), an honor code is a set of rules and principles that students agree to follow, which promotes respect, honesty, and responsibility. It must clearly define academic dishonesty, especially in a world where technologies facilitate access to online materials. The inclusion of explicit guidelines on the ethical use of AI tools is a critical element in creating an honor code.

Integrating a statement related to AI in the honor code helps avoid misunderstandings and helps students understand the expectations of using these tools. This statement should explicitly address whether AI use is acceptable in the course and outline the expectations for citation and acknowledgment of AI-generated sources. Furthermore, it is recommended to include a discussion on the capabilities, limitations, and ethical use of AI technologies. Faculty should also provide guidelines on how they will handle cases of inappropriate use of AI-generated work, ensuring a comprehensive understanding of the consequences and reinforcing the importance of academic integrity.

On the administrative side, given the rapid evolution of AI, it is recommended that higher education institutions adopt a proactive and

reflective approach, maximizing the benefits of AI, while addressing its inherent challenges. Administrators should consider how copyrighted and intellectual property are defined and protected when created, either fully or in part, using AI. However, these policies must be developed in accordance with US and international copyright laws, which are rapidly evolving to keep pace with new technologies. Therefore, it is advisable to collaborate with the institution's legal counsel in this process. Not doing so could put the institution in legal jeopardy (Sebesta & Davis, 2023a). According to Sebesta and Davis (2023b), administrators should engage faculty and staff from as many disciplines, departments, and offices as possible, both within the institution and externally in the industry, to develop comprehensive AI policies. This collaborative approach necessitates the dismantling of silos on campus to ensure the responsible and effective creation of holistic AI policies that reflect the interdisciplinary nature of the technology and its applications. Due to the dynamic nature and continual advancements of AI technologies, administrators should be prepared to periodically revisit and revise these policies to maintain their relevance and effectiveness. Likewise, it is essential to address possible biases in the results generated by AI to avoid discrimination and ensure equity in evaluation and feedback provided by artificial intelligence.

## Additional Considerations

Additional considerations of generative AI use of copyrighted materials must be addressed to uphold the rights of content creators in the deployment and use of AI technologies. Bainbridge (2023) elucidates the need to consider ways to mitigate risks and ensure responsible use such as intellectual property rights, bias and discrimination, privacy concerns, manipulation and misinformation, unintended consequences and accountability and transparency, human creativity and labor, and finally social impact. Müller (2023) concurs and admits that there is a degree of opacity with AI systems, stating “if the system involves machine learning, it will typically be opaque even to the expert, who will not know how a particular pattern was identified, or even what the pattern is. Bias in decision systems and data sets is exacerbated by this opacity” (Müller, 2023, *Opacity of AI Systems*, para. 30). Dwivedi et al. (2023) state:

Before adopting automated tools as aids in student learning, it's crucial to consider their ethical and societal impacts. The lack of transparency in how these models generate results means they function as "black box" AI tools, providing responses to queries without guaranteed accuracy. Without clear warnings, allowing students to use such tools could potentially cause more harm than benefit. (p. 25)

The responsible use of ChatGPT in research and education requires addressing potential ethical concerns. Researchers must ensure that AI-generated scenarios do not inadvertently perpetuate stereotypes or reinforce harmful beliefs. Data privacy and informed consent must also be considered when using AI-generated content in research and education (Senel, n.d.).

## Summary and Next Steps

While predicting the full extent of generative AI's future evolution is challenging, it is important to recognize the need for promptly establishing safeguards. As AI continues to be embedded in all aspects of our daily lives, careful consideration for the public interest could revolutionize copyright law and the fair use doctrine (Lin, 2023, pp. 239–240). According to Zawacki-Richter et al. (2019), these measures are essential not only for safeguarding copyright and addressing privacy and data protection but also for fostering creativity through generative technology. They add that it is imperative to put frameworks in place at the outset "for ethical governance for AI in education" (p. 2). Given the increasing ubiquity of AI, higher education institutions and organizations are actively engaged in understanding its benefits and challenges. Some have progressed further and are developing online resources to assist users in better comprehending and utilizing AI.

In conclusion, while significant strides have been made in leveraging AI for educational enhancement, there remains a critical need for comprehensive institutional policies addressing the ethical dimensions of AI use in higher education. This chapter underscores the imperative for colleges and universities to engage in ongoing, interdisciplinary dialogues to develop robust fair-use guidelines and ethical AI policies.

These frameworks should encompass all levels of the institution, from classroom applications to administrative processes, ensuring responsible AI integration that upholds academic integrity, protects student privacy, and promotes equitable access to AI-enhanced educational opportunities. By proactively addressing these ethical considerations, higher education institutions can position themselves at the forefront of responsible AI adoption, preparing students for an AI-driven future while maintaining the core values of academia.

## Discussion Questions

1. How do the principles of fair use apply differently to generative AI technologies compared to traditional educational tools, and what are the implications for academic integrity?
2. What challenges do universities face when developing policies that balance the benefits of generative AI tools with the need to protect intellectual property rights?
3. In what ways might the use of generative AI in higher education either exacerbate or mitigate issues of bias, and how should institutions address these concerns?
4. Considering the evolving nature of AI and copyright law, how can higher education institutions proactively adapt their policies to ensure compliance and ethical use of AI-generated content?
5. What are the potential consequences of allowing unrestricted use of generative AI tools in academic settings, and how might institutions mitigate these risks while fostering innovation?

## References

Atlas, S. (2023). *ChatGPT for higher education and professional development: A guide to conversational AI*. [https://digitalcommons.uri.edu/cgi/viewcontent.cgi?article=1547&context=cba\\_facpubs](https://digitalcommons.uri.edu/cgi/viewcontent.cgi?article=1547&context=cba_facpubs)

Bainbridge, O. (2023). Is the fair use doctrine a viable argument for generative AI? Honors Theses. [https://scholarworks.wmich.edu/honors\\_theses/3756](https://scholarworks.wmich.edu/honors_theses/3756)

Caulfield, J. (2023, April 24). University policies on AI writing tools, overview & list. Scribbr. [www.scribbr.com/ai-tools/chatgpt-university-policies/](http://www.scribbr.com/ai-tools/chatgpt-university-policies/)

Center for Teaching and Assessment of Learning. (n.d.). *Considerations for using and addressing advanced automated tools in coursework and assignments*. <https://ctal.udel.edu/advanced-automated-tools/>

Chan, C. K. Y. (2023). A comprehensive AI policy education framework for university teaching and learning. *International Journal of Educational Technology in Higher Education*, 20(1), 38. <https://doi.org/10.1186/s41239-023-00408-3>

Cingillioglu, I. (2023). Detecting AI-generated essays: The ChatGPT challenge. *The International Journal of Information and Learning Technology*, 40(3), 259–268.

Coffey, L. (2024). *How AI has begun changing university roles, responsibilities*. [www.insidehighered.com/news/tech-innovation/artificial-intelligence/2024/02/13/how-ai-has-begun-changing-university-roles](http://www.insidehighered.com/news/tech-innovation/artificial-intelligence/2024/02/13/how-ai-has-begun-changing-university-roles)

Creative Commons. (2024). About CC Licenses. <https://creativecommons.org/share-your-work/cclicenses/>

Davis, V. (2023). Developing institutional level AI policies and practices: A framework. WCET. [https://wcet.wiche.edu/frontiers/2023/12/07/developing-institutional-level-ai-policies-and-practices-a-framework/?utm\\_source=AdaptiveMailer&utm\\_medium=email&utm\\_campaign=WCET%20AI%20Policy%20Repository%20Announcement&org=1741&lvl=100&ite=2581&lea=898731&ctr=0&par=1&trk=](https://wcet.wiche.edu/frontiers/2023/12/07/developing-institutional-level-ai-policies-and-practices-a-framework/?utm_source=AdaptiveMailer&utm_medium=email&utm_campaign=WCET%20AI%20Policy%20Repository%20Announcement&org=1741&lvl=100&ite=2581&lea=898731&ctr=0&par=1&trk=)

Dwivedi, Y. K., et al. (2023). Opinion paper: “So what if ChatGPT wrote it?” Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, 71, 102642. <https://doi.org/10.1016/j.ijinfomgt.2023.102642>

Ferrer, J. (2023). *Learning evaluation in the era of artificial intelligence*. Independent publication, Aguada, Puerto Rico.

Hayes, C. M. (2024). Law and ethics of generative artificial intelligence and copyright. In K. Arai (Ed.), *Advances in information and communication. FICC 2024. Lecture notes in networks and systems* (Vol. 920). Springer. [https://doi.org/10.1007/978-3-031-53963-3\\_40](https://doi.org/10.1007/978-3-031-53963-3_40)

Helms, S., & Krieser, J. (2023). Copyright chaos: Legal implications of generative AI. Bloomberglaw. [www.bloomberglaw.com/external/document/XDDQ1PNK000000/copyrights-professional-perspective-copyright-chaos-legal-implic](http://www.bloomberglaw.com/external/document/XDDQ1PNK000000/copyrights-professional-perspective-copyright-chaos-legal-implic)

Intelligent.com. (2023, January 23). Nearly 1 in 3 college students have used ChatGPT on written assignments. [www.intelligent.com/nearly-1-in-3-college-students-have-used-chatgpt-on-written-assignments/](http://www.intelligent.com/nearly-1-in-3-college-students-have-used-chatgpt-on-written-assignments/)

Johnston, H., Wells, R. F., Shanks, E. M., Boey, T., & Parsons, B. N. (2024). Student perspectives on the use of generative artificial intelligence

technologies in higher education. *International Journal for Educational Integrity*, 20(2). <https://doi.org/10.1007/s40979-024-00149-4>

Kolade, O., Owoseni, A., & Egbetokun, A. (2024). Is AI changing learning and assessment as we know it? Evidence from a ChatGPT experiment and a conceptual framework. *Heliyon-Science Direct*, 10(4), 1–21.

Latman, A. (1960). *Copyright law revision*. Copyright Office. [www.copyright.gov/history/studies/study14.pdf](http://www.copyright.gov/history/studies/study14.pdf)

Lin, P. K. (2023). Fair's fair: How public benefit considerations in the fair use doctrine can patch bias in artificial intelligence systems. *Digital Repository @ Maurer Law*. [www.repository.law.indiana.edu/ijlse/vol11/iss2/1](http://www.repository.law.indiana.edu/ijlse/vol11/iss2/1)

Mills, A., Bali, M., & Eaton, L. (2023). How do we respond to generative AI in education? Open educational practices give us a framework for an ongoing process. *Journal of Applied Learning and Teaching*, 6(1), 16–30.

Müller, V. C. (2023). Ethics of artificial intelligence and robotics. In E. N. Zalta & U. Nodelman (Eds.), *The Stanford Encyclopedia of Philosophy* (Fall 2023). Metaphysics Research Lab, Stanford University. <https://plato.stanford.edu/archives/fall2023/entries/ethics-ai/>

Murray, M. D. (2023). Generative AI art: Copyright infringement and fair use. *SMU Sci. & Tech. L. Rev.*, 26, 259.

Northern Illinois University Center for Innovative Teaching and Learning. (n.d.). *Class policies for AI tools*. [www.niu.edu/citl/resources/guides/class-policies-for-ai-tools.shtml](http://www.niu.edu/citl/resources/guides/class-policies-for-ai-tools.shtml)

Quinnemanuel.com. (2024). Lead article: The fair use frontier: Copyright law in the age of AI and machine learning. [www.quinnemanuel.com/the-firm/publications/lead-article-the-fair-use-frontier-copyright-law-in-the-age-of-ai-and-machine-learning/](http://www.quinnemanuel.com/the-firm/publications/lead-article-the-fair-use-frontier-copyright-law-in-the-age-of-ai-and-machine-learning/)

Rowland, D. R. (2023). Two frameworks to guide discussions around levels of acceptable use of generative AI in student academic research and writing. *Journal of Academic Language and Learning*, 17(1), T31–T69.

Sag, M. (2023). Fairness and fair use in generative AI. *Fordham Law Review*. <https://fordhamlawreview.org/issues/fairness-and-fair-use-in-Generative-ai/>

Samberg, R., Vollmer, T., & Teremi, S. (2024). *Fair use rights to conduct text and data mining and use artificial intelligence tools are essential for UC research and teaching*. Office of Scholarly Communication. <https://osc.universityofcalifornia.edu/2024/03/fair-use-tdm-ai-restrictive-agreements/>

Sebesta, J., & Davis, V. L. (2023a, December). AI policies & practices toolkit. <https://wcet.wiche.edu/resources/ai-practices-and-policies-toolkit>

Sebesta, J., & Davis, V. L. (2023b). *Supporting instruction and learning through artificial intelligence: A survey of institutional practices & policies*. WICHE

Cooperative for Educational Technologies. [wcet.wiche.edu/resources/wcet-report-supporting-instruction-learning-through-artificial-intelligence-a-survey-of-institutional-practices-policies/](http://wcet.wiche.edu/resources/wcet-report-supporting-instruction-learning-through-artificial-intelligence-a-survey-of-institutional-practices-policies/)

Senel, B. (n.d.). *Exploring ChatGPT in research and education*. Sage. <https://us.sagepub.com/en-us/nam/exploring-chatgpt-in-research-and-education>

Snow, N. (2011). The forgotten right of fair use. *Case Western Reserve Law Review*, 62(1), 135–174. University of South Carolina Scholar Commons. [https://scholarcommons.sc.edu/cgi/viewcontent.cgi?article=1894&context=law\\_facpub](https://scholarcommons.sc.edu/cgi/viewcontent.cgi?article=1894&context=law_facpub)

Stim, R. (2017, April 10). *Measuring fair use: The four factors*. Stanford Copyright and Fair Use Center; Stanford Libraries. <https://fairuse.stanford.edu/overview/fair-use/four-factors/>

The University of Texas at Austin, Center for Teaching and Learning. (n.d.). *Generative AI in teaching and learning: Introduction*. <https://ctl.utexas.edu/teaching-technology/generative-ai-teaching-and-learning-introduction>

West, D. M. (2018). *What is artificial intelligence?* Brookings Institute. [www.brookings.edu/articles/what-is-artificial-intelligence/](http://www.brookings.edu/articles/what-is-artificial-intelligence/)

Yavorski, K. (2023). The increasing relevance of honor codes. <https://kimberlyyavorski.com/blog/education-articles/>

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education—Where are the educators? *International Journal of Educational Technology in Higher Education*, 16(1), 39. <https://doi.org/10.1186/s41239-019-0171-0>



**Taylor & Francis**  
Taylor & Francis Group  
<http://taylorandfrancis.com>

# Part IV

## Preparing Educators and Students for AI Integration



**Taylor & Francis**  
Taylor & Francis Group  
<http://taylorandfrancis.com>

# Teaching Generative AI in Higher Education: Strategies, Implications, and Reflective Practices **10**

*Andrew Kelly, Miriam Sullivan, Katrina Strampel*

## Introduction

Generative artificial intelligence tools have significantly transformed the global higher education landscape. Such a transformation offers multiple benefits for learning. The ubiquity and ease of use of these tools, through natural language prompts, can support students in learning complex concepts, testing their understanding, and organizing ideas for academic work. Alongside these benefits, however, there are also risks. Generative AI tools can complete tasks such as essay writing, coding, and numerical calculations easily, and it is highly likely that the computational power of these large language models will only increase in sophistication and quality over the coming years. This necessitates a serious rethink about assessment design across almost all disciplines. There are also significant ethical and privacy considerations in the use of these tools of which higher education institutions, and indeed society in general, are still scratching the surface.

As these tools become more powerful and further integrated into popular product suites such as the Microsoft- and Google-based platforms,

the need to guide and support students to use them appropriately in a tertiary context becomes increasingly critical. Reports published in the past 12 months suggest student usage of generative AI is outpacing that of faculty teaching staff, and that institutions have yet to radically transform their assessments to address the impact of generative AI on learning assurance (Coffey, 2023; Freeman, 2024). Students are also looking for more support from their institutions. For example, a February 2024 report conducted by the Higher Education Policy Institute, which surveyed 1,250 students, found that less than a quarter of respondents were satisfied with the support they have received regarding generative AI. Moreover, fewer than 10% were provided with institutional access to a generative AI tool (Freeman, 2024).

More work is clearly needed to teach students about generative AI and how to use it, though such an undertaking will be challenging at scale. University students are incredibly diverse. In addition to different linguistic, social, and cultural backgrounds, students will also possess varied digital literacy skills and experience in using generative AI tools. Student confidence in using generative AI will also be influenced by their prior experience with these tools before attending university. In other words, students that have used these tools in secondary education or for private use before enrollment will have an advantage over students that have not engaged with these tools previously. Similarly, teaching students requires supporting and upskilling faculty in their awareness and application of generative AI within their respective disciplines, as many faculty may have limited experience or exposure to these tools. The tools are also evolving rapidly, which requires continually updating training and education programs to reflect a fast-changing landscape.

To this end, this chapter takes a broad approach to exploring the complexities and ways in which higher education institutions can teach students about using generative AI. It first situates these topics within the current literature and analyses some of the key quality assurance, ethical, privacy, equity, and access considerations in a tertiary teaching and learning context. It also explores generative AI in a curriculum design context, as the implications for teaching and student learning will be significant when considering aspects such as constructive alignment, assurance of learning, and academic preparedness. This exploration also discusses two similar, yet distinct,

lenses with which to view this topic: *explicit* teaching of generative AI (e.g., an introduction to the basics of using it and how it works), and *implicit* teaching of generative AI (e.g., embedding it into subject activities and assessments). Throughout the chapter, case studies and practical strategies for educators to use when teaching students about generative AI are presented. Finally, this chapter ends by posing some reflective questions for both staff and students to consider the long-term implications of generative AI in university teaching.

## The Impact of Generative AI on Higher Education Learning and Teaching: Quality Assurance

The use of generative AI in the learning and teaching setting raises concerns about quality assurance, particularly regarding student outcomes demonstrated through assessment. Assessment integrity has come under increasing scrutiny worldwide, with many education governing bodies challenging higher education institutions to address the threat posed by generative AI to the security and validity of assessments (Endris et al., 2024). For example, the Australian Tertiary Education Quality and Standards Agency is asking all higher education institutions to provide an institutional action plan to address the risk generative AI poses to the integrity of the awards given to students (Australian Government Tertiary Education Quality and Standards Agency, 2024). In the United Kingdom, the Quality Assurance Agency (QAA) has reminded providers to review the 2020 *Academic Integrity Charter for UK Higher Education* and “reflect on the steps they have taken to date, to reassure themselves that they are reasonable, proportionate and meet the needs of their whole community” (QAA, 2023, p. 2). However, the QAA also outlines actions for higher education providers with a four-step process that relies on course teaching teams bringing unexpected grade patterns or unusual activity to the Board of Examiners. It follows that Chairs of these examination boards, as well as other academic leaders across the institution, should share information and develop action plans related to responding to generative AI threats. However, currently fewer than half of the top ranked universities have publicly available guidelines for generative AI use in assessments (Moorhouse et al., 2023). Where policy is unclear, students, in turn,

develop their own varying opinions on what constitutes acceptable and unacceptable use (Chan, 2023a).

These actions are focusing on current risk to award integrity, but discussions sector-wide are starting to move towards rethinking academic integrity more broadly. Typically, the argument is that using AI tools is plagiarism and will give students who use it an unfair advantage on grades (e.g. Ibrahim et al., 2023). Currently, there is little practice-based evidence that using generative AI tools provides students with a grade advantage (Mennella & Quadros-Mennella, 2024). It may be that students are using the tools ineffectively, or perhaps assessments were a poor gauge of assessing student capabilities. For example, Sheese et al. (2024) integrated a large language model assistance tool into a programming unit. They found that use of the tool was modestly correlated with grade performance, but that most students used unsophisticated prompts that helped them complete an immediate task but would not improve their overall understanding. Most tools for generative AI detection measure the “proportion” of non-human generated text (Weber-Wulff et al., 2023), which is not necessarily a proxy for learning. Eaton (2023) argues that as hybrid human–AI writing becomes normalized, academic integrity becomes less about language and writing, and more about being responsible for verifying information and attribution. It is therefore important that we focus on assuring the learning *process*, rather than on document authorship (Wise et al., 2024). For the most part, this requires a cultural shift in higher education and curriculum transformation at scale.

### Case Study: Taking an Educative Approach to Quality Assurance

In a first-semester postgraduate business unit, the teaching staff embedded generative AI activities into class sessions and discussed its appropriate use for the first assignment. However, when the assignment was submitted, it was clear that many students had used generative AI without acknowledgement. Rather than reporting the students for academic misconduct, the Unit Coordinator offered a short amnesty for students to include an acknowledgement to their assignment. This was supported

with explicit instructions on how to word an acknowledgement, and where it could be submitted in the assignment portal. This educative approach led to approximately one-third of students adding an acknowledgement of the use of artificial intelligence tools, and provided the insights into how the tools were being used, which was primarily for initial brainstorming and grammar feedback. This suggests this student cohort required additional training in using generative AI for deeper learning.

## Ethical Concerns

Higher education institutions have a vested interest in ensuring that the use of generative AI tools by their students and staff is conducted ethically and securely. Ensuring ethical use is challenging because the companies that own these tools operate in diverse regulatory environments, and there is not yet a widespread consensus on what ethical use entails in practice. There is also uncertainty as to whether *any* use of generative AI tools can be considered ethical. For instance, much of the debate of the ethical use of generative AI in higher education has pertained to the systemic bias of large language models, data exploitation, validity of information, often referred to as *hallucinations* (Amoozadeh et al., 2023), as well as the potential for unethical or malicious use of the tools (Kasneci et al., 2023; Nguyen et al., 2022; Yan et al., 2023). Education providers have also identified that the impact on students might include “discrimination, inequality for marginalized groups of students and xenophobia” (Nguyen et al., 2022, p. 4223) triggering a need for risk identification and mitigation strategies (Nguyen et al., 2022). According to Yan et al. (2023), such caution has led to concerns that the ethicality of generative AI, or lack thereof, may “hinder future research and the adoption of LLMS-based innovations in authentic educational systems” (Yan et al., 2023, p. 1). In this particular study, none of the 118 innovations using generative AI assessed were found to be transparent for educational stakeholders such as teachers, students, and parents.

While ethical use remains a murky issue, there has been steady progress towards building a shared understanding of the expectations

of the ways in which these tools should be engaged appropriately. Looking broadly, UNESCO hosted a global forum in early 2024 to seek international agreement on principles that should guide the use of these tools. Describing such governance as “one of the most consequential challenges of our time” (para. 1) the forum led to the publication of values and principles that frame an ethical approach to artificial intelligence (UNESCO, 2024). Establishing clear frameworks for appropriate use will be critical in the higher education context. In Chan’s (2023b) study, for example, both staff and students rated AI governance, including data privacy and ethics, as one of their main concerns.

### Case Study: Artificial Intelligence Framework at an Australian University

Edith Cowan University, a mid-sized public university based in Western Australia, responded to the emergence of generative AI by establishing a framework to guide its use across the institution (see Figure 10.1). It was designed to support judgments,

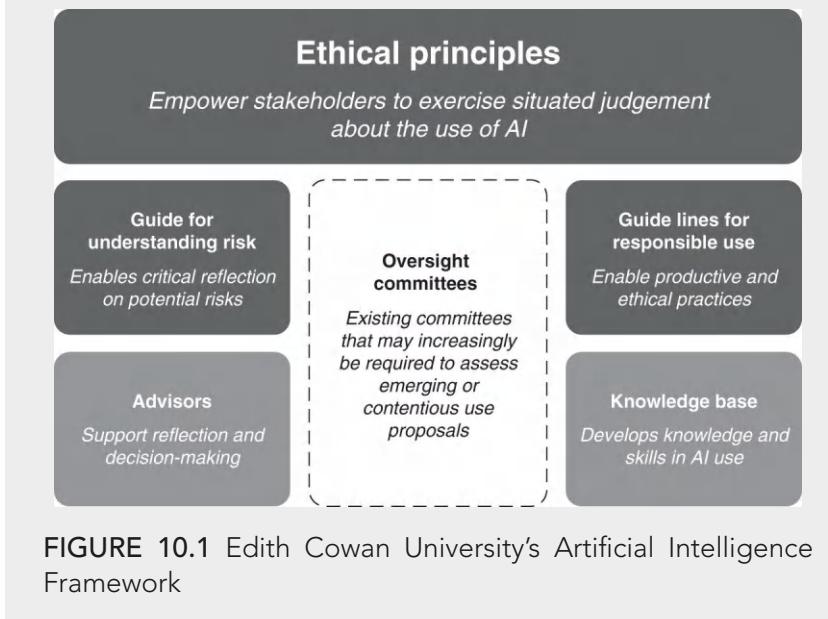


FIGURE 10.1 Edith Cowan University's Artificial Intelligence Framework

guide institutional decision making, and as far as practicable, leverage existing policies and processes to identify and manage risk, and enhance human capability (ECU, 2023). Sitting alongside this framework are guidelines for curriculum, teaching, and assessment, which inform how staff should interpret the framework's principles and apply them in their teaching practice.

## Equity and Access

Learning technologies have long impacted curriculum design, with varying affordances for communication, collaboration, content delivery, and assessment. The focus on these affordances aligns to enhanced student outcomes and opportunities for flexibility (Hill et al., 2021). What is especially salient now, however, is the unequal access students may have to learning technologies that are powered by artificial intelligence across institutions both prior to attending university and when enrolled in university. Some high schools, colleges, and universities will invest substantially more in generative AI tools than others, thereby increasing a digital divide between some groups of university students compared to others (Hill et al., 2021).

This is particularly relevant in an artificial intelligence context, as not all students will necessarily be able to access and leverage these benefits during their study. Students that belong to one or more equity groups may be disadvantaged in using these tools. For example:

- Financial hardship limits capacity for students to purchase high-powered versions of artificial intelligence tools.
- Students from non-traditional or low socioeconomic backgrounds may not have extensive experience with engaging in digital platforms that are generative-AI powered.
- Living in regional and remote areas can limit reliable internet access to these tools regularly.

It is recommended that institutions and disciplines consider granting student access to generative AI tools in order to make their use equitable before adopting and integrating tools into the curriculum. It may

be that extra or co-curricular activities will be required to ensure equitable access and use. Course teaching teams may also need to design explicit diagnostic and support activities in early semesters to ensure all students have relevant and appropriate skills to use generative AI in their learning experiences (see the section “Academic Preparedness and Constructive Alignment” below).

## Curriculum Design

Generative AI will impact curriculum design in many different ways over the coming years, including some that educators may not yet have begun to fully comprehend. To date, there is much already written about the potential use of large language models for productivity and efficiency in relation to course mapping, learning outcome generation, lesson planning, task design, resource recommendations, question generation for assessments, providing feedback on drafts and final assessments, and grading written assessment (e.g., essays and short answers) (An Ngo, 2023; Yan et al., 2023; Yu & Guo, 2023). Further potential benefits have been touted for administrative elements of teaching practice. This includes timetabling, tracking student achievement and engagement, allocating resources, and providing targeted information (Nguyen et al., 2022).

On the surface, the potential time saved from using generative AI as a curriculum design assistant would be enticing for academic staff to consider. However, it is worth pausing to consider other implications of such use. Is there an established framework to guide use by teaching staff at their respective institutions? How will a generative AI tool store and train itself on the intellectual property of a particular curricula? Does overreliance on generative AI tools undermine the role of the teaching staff member, and how will the quality and contextual features of the particular course be ensured? Some of these questions are challenging, and not easy to answer. Moreover, staff perceptions of generative AI are incredibly diverse and will shape the extent to which tools are used for curriculum design purposes. Dwivedi et al. (2023), for instance, found that staff perspectives across disciplines such as computer science, marketing, education, and health differed substantially with respect to the opportunities that tools like ChatGPT offer, as well as the risks relating to privacy, security, and reliability of information.

Universities worldwide are starting to transform their curriculum at-scale as a means to increase the integrity of award courses and to teach students about generative AI in the context of their disciplines. An example of this is evident in the approach taken by the American Association of Colleges & Universities (AAC&U) with an institute for “AI, Pedagogy, and the Curriculum.” In a world where generative AI is ubiquitous, the “moral purpose” (Fullan & Scott, 2009) of higher education becomes a critical lens to apply to curricular development and teaching practice. Crawford et al. (2023) note that “teacher role modeling, through leadership development opportunities, or through continuous self-awareness, ethics, and decision-making training to build critical thinkers” is necessary to “combat prospective cheating or misuse of the ChatGPT application, and future artificial intelligence chatbots and tools” (p. 7). These ideas support a clear focus on human capabilities that are unlikely to be replicated with artificial intelligence.

To integrate generative AI into the curriculum, foundational concepts of curriculum and assessment design should be applied. Given the newness of generative AI and the continuously changing nature of the tools that are being developed, it is recommended that university educators take a whole-of-course approach to design that is led by course coordinators and supported by central learning and teaching services. The following principles (Hill et al., 2021, pp. 61–62) can be used to guide integration of generative AI into a course curriculum: vision; cohesion and mapping; constructive alignment; academic preparedness; assurance of learning; and authentic design. These principles will be explored later in the chapter.

In the curriculum design process, consider if the practices being implemented should be *explicit* or *implicit* and whether that will change over time. An explicit curriculum approach refers to intentionally directing learners towards engaging with desired content matter or skill development. It specifically explains a concept, why it is important, and how to apply it. In the case of teaching students how to use generative AI, an explicit approach might include sharing an introductory video about ChatGPT with a demonstration of some of the outputs it can produce. An implicit approach, on the other hand, is a design process whereby curriculum is structured in ways that enable learners to develop specific skills automatically as they progress through their

study. Such an approach tends to be integrated and contextualized to the particular course being studied. One example of this approach could include assessment tasks that enable learners to analyze content-specific outputs from a generative AI tool.

There is no one-size-fits-all approach between explicit and implicit methods. Some courses might necessitate more direct teaching about generative AI than others, such as in the fields of computer science or linguistics. Regardless of discipline, a well-balanced curriculum will also incorporate appropriate explicit teaching about generative AI in the first year of a course and gradually transition to implicit approaches as students develop their artificial intelligence literacy skills. Over the next decade, however, it is worth pausing to consider the extent to which experience with artificial intelligence might become assumed or expected knowledge upon entry. Generative AI will gradually be integrated into many technologies that people use as part of their everyday life and may also be incorporated into curricula in secondary education. While such experience will certainly not mean that all students will be equally prepared to succeed, it is reasonable to predict that, taking a longer term perspective over the next decade or two, most commencing university students will have used these tools before. Consequently, learners will need more specific guidance about their applications in respective disciplines rather than learning the basics.

### Case Study: Explicit Teaching Through an Artificial Intelligence Workshop

At one university, students are entering their study through a range of pathways and have diverse backgrounds. In order to support their transition to study, the Library and Learning Adviser teams offer study skills workshops during the first six weeks of each semester. In 2023, they introduced a workshop specifically on ChatGPT and other generative AI tools to support students with using them ethically and responsibly in their studies. The workshop focused on understanding how generative AI tools work, and introduced different tools, basic prompt construction, appropriate use in assessment work, and example prompts for

each stage of the research and writing process. At the end of the workshop, student confidence in using generative AI tools had significantly improved, and student ideas about how they could use tools were more specific and practical than before the workshop (Sullivan et al., 2024).

## Vision

When thinking about your curriculum vision, it will help to work with your course teaching team to reflect on your professional and institutional values, goals, and the intended learning outcomes for your students. For example, your university may have explicitly stated values and strategic goals on innovation or social justice. You will need to consider how these will be reflected in the context of generative AI. You may also have industry partners with expectations of skills and use of digital tools, or your discipline professional body may have specific recommendations on the use of generative AI. All of these factors will influence the vision for your course curriculum and the integration of generative AI into subjects across the course to support employability and employment outcomes for future graduates. In developing a course vision, human capabilities that are unlikely to be replaced by artificial intelligence may be revealed, including ethical decision making and the development of new ideas. You will need to be aware of these as you work collaboratively to set a vision for learning and teaching about and with generative AI across the course.

## Cohesion and Mapping

As a whole-of-course teaching team, you will need to think about when, where, and how students are learning to use generative AI. It is important for your students to understand the connection between subjects. You can do this by explicitly connecting the learning that is happening in each unit so they have a clear understanding of both what they have learned and how they will use that learning in their career and life (Fung, 2017). For example, they may learn about using generative AI to develop patient case notes in one unit, thus using it as a productivity

tool. In another unit, they may explore the risks of using generative AI without verifying facts and figures by comparing different data sources. Without the instructor explicitly connecting these lessons for students, they may not apply what they have learned about risk and ethical data practices to their use of generative AI tools for productivity.

To help students see the connections between what they are learning implicitly and explicitly with generative AI, it is helpful to map your curriculum within individual subjects and across the course. Curriculum mapping is an approach that spatially represents the connections between various curriculum elements (such as learning outcomes, activities, assessment, and content). Ensuring horizontal and vertical alignment helps ensure learning and cohesion within and across year levels. Table 10.1 outlines a structured approach to building student proficiency in utilizing generative AI throughout a course.

TABLE 10.1 A Scaffolded Approach to Developing Student Capabilities in Using Generative AI Across a Course

Stage	Generative AI Knowledge Required	Examples
Commencing: Transition to University	<ul style="list-style-type: none"> <li>Basics of prompt engineering</li> <li>Understand academic integrity</li> <li>AI ethics and responsibility</li> <li>Developing evaluative judgment and critical thinking</li> </ul>	Mandatory AI module for commencing students, extra-curricular AI workshops, AI training in first-year communication skills units, study-assist chatbots
Specialization: Consolidating Knowledge	<ul style="list-style-type: none"> <li>Discipline-specific use of generative AI</li> <li>Discipline-specific risks in generative AI use</li> </ul>	Critical engagement with AI output, learning specific AI programs for their discipline, AI simulations, discipline-specific AI policy, and ethics
Capstone: Transition to Employment	<ul style="list-style-type: none"> <li>Using generative AI in the workplace</li> <li>Employability</li> </ul>	Work placements with stakeholders, extra-curricular workshops on using AI to support job searching, implementing AI solutions to discipline-specific problems

## Academic Preparedness and Constructive Alignment

Unless you are developing a completely new subject or course about generative AI, you will need to integrate it into your existing curriculum. It is important that generative AI is not just “tacked on” superficially with generic content or quizzes. Instead, your role will be to engage students critically with generative AI and help them develop the skills to use it appropriately within their disciplinary context. To do this, it is helpful to follow a backwards design approach (McTighe & Wiggins, 2012). This includes:

- Setting intended learning outcomes about artificial intelligence in your subjects that are aligned to your course learning outcomes. Industry standards and accreditation requirements also need to be taken into account. Your course may already have a course learning outcome about artificial intelligence literacy (Ng et al., 2021) or similar literacies relating to digital skills that could be adapted.
- Designing assessment and enough opportunities for feedback.
- Planning teaching activities and identifying appropriate learning resources.

In your classroom practice, you will need to think about what knowledge and skills your students may already have (McArthur, 2023). This is especially relevant for commencing students, and it is important to take an equitable approach to assisting all new students build the requisite skills to engage with these tools effectively. Some students may not have ever knowingly used generative AI tools or may not have used them for learning. Alternatively, others may have fully adopted their use for all aspects of their learning (Kelly et al., 2023). To gain a better understanding of your students’ knowledge and skills, you may want to design a diagnostic test or background knowledge probe at the start of a course (Barkley, 2016). This could include a simple test of whether students can successfully identify different generative AI tools, the ways in which they can be used, and differentiating outputs from other forms of text that can be found on the internet.

A well-designed course that incorporates generative AI effectively will include implicit and explicit learning activities that help students

achieve the intended learning outcomes. For example, in a first-year subject, you may focus on foundational concepts about generative AI, including ethical concerns, and simplistic use to understand its limitations. One introductory learning activity might include a general presentation about generative AI that covers the basics of what it is, what it looks like, how it works, its benefits, and its risks.

Another activity could include students critiquing generative AI outputs about an introductory concept, and then discussing the pros and cons of the output content in their disciplinary context. In the middle years, your focus for helping students to learn about, and with, generative AI will need to build on the foundational aspects but begin to develop critical, creative, and practical thinking skills related to its use. Students should also be supported to make connections between academic work and other areas of life (Barkley, 2016). By the final years, students should be able to demonstrate mastery of content knowledge and demonstrated capacity to use generative AI appropriately in complex discipline-specific ways. This is especially vital given the ever-changing generative AI landscape across a wide range of industries.

### Case Study: Learning Outcomes Focused on Artificial Intelligence

In addition to designing learning activities and assessments, appropriate use of and engagement with artificial intelligence tools should be integrated into the learning outcomes of a subject or course. Introductory subject learning outcomes might specify that students can identify and recognize generative AI outputs, middle year subjects might specify that students can apply these outputs in producing authentic discipline-specific tasks, and final year subjects might specify that students critically analyze, create, or make complex ethical decisions about generative AI use in their discipline. Examples of these types of more advanced learning outcomes include:

- Interact effectively with artificial intelligence to produce a contemporary marketing plan for tailored industry products.

- Make complex ethical decisions about the appropriate use of artificial intelligence in public health care settings.
- Collaborate with generative AI tools to create a contemporary teaching plan for early childhood learners.

## Assurance of Learning

Throughout your subject and course, students need to be given opportunities to learn implicitly and explicitly about generative AI and use it in appropriate ways within the discipline. This includes responsible and appropriate use in the completion of assessment tasks. As previously discussed, you will also need to provide plenty of opportunities for students to practice engaging with and discussing generative AI. It is important that during their practice, you engage in feedback dialogue (Carless, 2016) to enable students to build their generative AI skills and knowledge until they are able to demonstrate mastery in their final assessments. Scaffolding skills development in subjects and courses with feedback dialogues will help ensure students are achieving the course learning outcomes.

### Case Study: Liu and Bridgeman's (2023) "Two Lanes" for Assessing Generative AI

Two researchers at the University of Sydney, Danny Liu and Adam Bridgeman, argue the importance of taking a *two-lane* approach for assessing generative AI. The first lane focuses on the assessment of learning and includes traditional tasks used to ensure the achievement of learning outcomes prior to the advent of tools like ChatGPT. These tasks include in-class contemporaneous assessments, viva voces, simulation-based assessments, and supervised examinations.

The second lane focuses on collaboration between humans and generative AI tools in assessment *as* learning. Tasks in this lane might include students using generative AI to brainstorm ideas

in the preparation of a major writing assessment, using outputs as part of the research process, and prompting a generative AI tool to draft an artefact (such as a policy brief or SWOT analysis). In each of these examples, students would then include the generative AI outputs used in the appendices of an assessment submission.

Liu and Bridgeman posit that there is no middle ground between these two lanes. In other words, it is reasonable to assume that any tasks outside the first lane (i.e., ones with limited assessment security) will likely involve the use of generative AI tools. There may, however, be some crossover between the two lanes.

For instance, an in-class presentation on a marketing strategy for an IT product might require students to discuss the role of generative AI tools in developing the strategy within the industry context. Regardless of the assessment approach across a course, the researchers suggest a “balance between assurance and human-AI collaboration” (Liu & Bridgeman, 2023, para 10). In other words, a course needs to include both high security assessment tasks as well as tasks that focus more on learning to use generative AI. It cannot rely solely on one lane of assessment.

## Authentic Design

All course curricula should be designed to cultivate a future-ready workforce proficient in the ethical and responsible use of generative AI. Over the past decade, there has been an emphasis on creating curricula that enable students to engage with global issues and foster their agency in a rapidly evolving world (Fung, 2017). In the context of generative AI, it is important for university educators to continuously update curricula to ensure its relevance and alignment with current advancements. Although keeping curricula up-to-date can be daunting, collaborating with the entire teaching team can facilitate this process. Additionally, individual educators can implement strategies to ensure that the curriculum, including assessment and teaching practices, remains authentic and relevant. For instance, incorporating student voice into course design can be achieved through activities such as

conducting focus groups and soliciting feedback from former students on designing engaging and contemporary assessment tasks. Ensuring peer-to-peer support and feedback mechanisms are in place can also enhance learning and accountability in the context of generative AI. This helps prepare students for authentic workplace culture by valuing constructive feedback and integrity.

Engaging with industry partners to understand their use of generative AI is another critical element to authentic design. This encompasses both the productivity and applied use of generative AI within disciplinary contexts, as well as a critical understanding of the challenges and shortcomings identified by industry bodies relevant to the discipline. Staying abreast of industry developments in areas of specialization can help faculty modify their activities to ensure students are using generative AI tools in contemporary ways. One introductory example of an industry-focused approach could involve inviting guest presenters to discuss how their industry is responding to generative AI and adapting their practices accordingly. Opportunities for students to engage in work-integrated learning or industry-set projects should be designed. This will enable the application of academic knowledge in a workplace setting while navigating the use of generative AI in a practical context. Facilitating opportunities for students to share their experiences and engage in critical reflection, as well as encouraging comparative analysis of their experiences with those of their peers, will enhance their preparedness for the complexities they may encounter upon graduation. For example, students working in public health contexts may be prohibited from using generative AI in their practice. In contrast, their counterparts working in private health environments may have extensive opportunities to utilize generative AI. Sharing these experiences with each other, critiquing the benefits and drawbacks of both, and formulating an ethical and responsible approach for each setting could help students be prepared to enter either workplace.

Lastly, continuous reflection on what is uniquely human within the discipline is essential to provide an authentic curriculum. It is important for students to recognize that generative AI will likely never fully replace human capabilities and dispositions. Machines lack genuine empathy, and algorithms in large language models cannot create new knowledge related to empathetic ways of thinking and being. By emphasizing the development of distinctly human capabilities within the curriculum,

educators can ensure that their programs remain authentic and contemporary in a world where generative AI increasingly integrates into work and life.

## Conclusion

Using generative AI in university teaching is a dual-edged sword—it offers unprecedented opportunities for enhancing student learning, while simultaneously challenging traditional pedagogical frameworks and ethical norms. As these tools become more sophisticated and integrated into educational platforms, it is imperative that institutions not only adapt their assessment designs but also provide comprehensive support and training for both students and faculty. The disparity in digital literacy and prior exposure to generative AI among students also necessitates a tailored approach to education, ensuring equitable access and understanding of these powerful tools. By embracing both explicit and implicit methods of teaching about generative AI, educators can equip students with the critical skills needed to navigate and leverage these tools effectively, fostering a future-ready workforce adept at ethical and responsible use of AI in their academic and professional pursuits.

## Discussion Questions

There are many critical lenses through which the use of generative AI can be viewed in a university teaching and learning context, many of which have been explored throughout this chapter. The four questions below are designed to prompt reflection for teaching staff and students. Educators might also consider using the questions for students as a class discussion activity.

### Teaching Staff

1. How can generative AI complement your teaching practice? Consider this question from different perspectives, including curriculum planning, lesson plans, subject activities, and assessment.

There may be new opportunities to strengthen your own preparation for classes and engage with students.

2. At what point(s) in your course or discipline should generative AI not be encouraged? Why? There are limits to the role that generative AI should play in teaching and learning. An overreliance on these tools can marginalize the role of educators in supporting student learning and the extent to which students demonstrate the achievement of learning outcomes. Each discipline is different, so consider areas in your teaching and curriculum where these tools should not be encouraged or used.

## Students

1. How will you use generative AI to learn at university? Once you have a good understanding of the benefits and limitations of using generative AI, reflect on how you can use these tools for learning new concepts, testing your own knowledge, and drafting writing structures. There are also limitations and risks to using these tools, which you will also need to consider in any generative AI use.
2. Are there risks in relying too much on generative AI? If so, what are they and why are they significant? If not, why do you think that is the case? Reflect on the longer-term impact if you rely too heavily on generative AI. While you are a student, you need to take accountability for your own learning. When you graduate, you will need to demonstrate to employers the value that you will offer that cannot be provided by generative AI tools.

## References

Amoozadeh, M., Daniels, D., Nam, D., Chen, S., Hilton, M., Ragavan, S. S., & Alipour, M. A. (2023). Trust in generative AI among students: An exploratory study. *arXiv:2310.04631*. <https://doi.org/10.48550/arXiv.2310.04631>

An Ngo, T. T. (2023). The perception by university students of the use of ChatGPT in education. *International Journal of Emerging Technologies in Learning (Online)*, 18(17), 4–19. <https://doi.org/10.3991/ijet.v18i17.39019>

Australian Government Tertiary Education Quality and Standards Agency. (2024, November 28). *Gen AI strategies for Australian higher education: Emerging*

practice. [www.teqsa.gov.au/guides-resources/resources/corporate-publications/gen-ai-strategies-australian-higher-education-emerging-practice%20poses%20to%20award%20integrity](http://www.teqsa.gov.au/guides-resources/resources/corporate-publications/gen-ai-strategies-australian-higher-education-emerging-practice%20poses%20to%20award%20integrity))

Barkley, E. F. (2016). *Learning assessment techniques: A handbook for college faculty*. John Wiley & Sons.

Carless, D. (2016). Feedback as dialogue. In M. Peters (Ed.), *Encyclopedia of educational philosophy and theory*. Springer. [https://doi.org/10.1007/978-981-287-532-7\\_389-1](https://doi.org/10.1007/978-981-287-532-7_389-1)

Chan, C. K. Y. (2023a). Is AI changing the rules of academic misconduct? An in-depth look at students' perceptions of "AI-giarism." *arXiv preprint*. <https://arxiv.org/pdf/2306.03358.pdf>

Chan, C. K. Y. (2023b). A comprehensive AI policy education framework for university teaching and learning. *International Journal of Educational Technology in Higher Education*, 20(1), 38. <https://doi.org/10.1186/s41239-023-00408-3>

Coffey, L. (2023). Students outrunning faculty in AI use. *Inside Higher Ed*. [www.insidehighered.com/news/tech-innovation/artificial-intelligence/2023/10/31/most-students-outrunning-faculty-ai-use](http://www.insidehighered.com/news/tech-innovation/artificial-intelligence/2023/10/31/most-students-outrunning-faculty-ai-use)

Crawford, J., Cowling, M., & Allen, K. A. (2023). Leadership is needed for ethical ChatGPT: Character, assessment, and learning using artificial intelligence (AI). *Journal of University Teaching & Learning Practice*, 20(3), 2. <https://doi.org/10.53761/1.20.3.02>

Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., ... & Wright, R. (2023). "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, 71(102642), 1–63. <https://doi.org/10.1016/j.ijinfo.mgt.2023.102642>

Eaton, S. E. (2023). Postplagiarism: Transdisciplinary ethics and integrity in the age of artificial intelligence and neurotechnology. *International Journal for Educational Integrity*, 19(1), 23. <https://doi.org/10.1007/s40979-023-00144-1>

ECU. (2023). *Artificial intelligence framework*. Edith Cowan University. [www.ecu.edu.au/centres/centre-for-learning-and-teaching/artificial-intelligence-framework](http://www.ecu.edu.au/centres/centre-for-learning-and-teaching/artificial-intelligence-framework)

Endris, A., Tlili, A., Huang, R., Xu, L., Chang, T., & Mishra, S. (2024). Features, components and processes of developing policy for artificial intelligence in education (AIED): Toward a sustainable AIED development and adoption. *Leadership and Policy in Schools*, 1–9. <https://doi.org/10.1080/15700763.2024.2312999>

Freeman, J. (2024). Provide or punish? Students' views on generative AI in higher education. *Higher Education Policy Institute*. [www.hepi.ac.uk/2024/02/01/provide-or-punish-students-views-on-generative-ai-in-higher-education/](http://www.hepi.ac.uk/2024/02/01/provide-or-punish-students-views-on-generative-ai-in-higher-education/)

Fullan, M., & Scott, G. (2009). *Turnaround leadership for higher education*. Jossey-Bass.

Fung, D. (2017). *A connected curriculum for higher education*. UCL Press.

Hill, A., Readman, K., & Strampel, K. (2021). Curriculum frameworks. In L. Hunt & D. Chalmers (Eds.), *University teaching in focus: A learning-centred approach* (2nd ed., pp. 53–80). Routledge. <https://doi.org/10.4324/9781003008330>

Ibrahim, H., Liu, F., Asim, R., Battu, B., Benabderrahmane, S., Alhafni, B., ... & Zaki, Y. (2023). Perception, performance, and detectability of conversational artificial intelligence across 32 university courses. *Scientific Reports*, 13(1), 12187. <https://doi.org/10.1038/s41598-023-43998-8>

Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., ... & Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, 103, 1–9. <https://doi.org/10.1016/j.lindif.2023.102274>

Kelly, A., Sullivan, M., & Strampel, K. (2023). Generative artificial intelligence: University student awareness, experience, and confidence in use across disciplines. *Journal of University Teaching & Learning Practice*, 20(6). <https://doi.org/10.53761/1.20.6.12>

Liu, D., & Bridgeman, A. (2023, July 12). What to do about assessments if we can't out-design or out-run AI? *Teaching@Sydney—University of Sydney*. <https://educational-innovation.sydney.edu.au/teaching@sydney/what-to-do-about-assessments-if-we-cant-out-design-or-out-run-ai/>

McArthur, J. (2023). 10 minute chats on generative AI. *Learning and Teaching: Teach HQ*, Monash University. [www.monash.edu/learning-teaching/TeachHQ/Teaching-practices/artificial-intelligence/10-minute-chats-on-generative-ai](http://www.monash.edu/learning-teaching/TeachHQ/Teaching-practices/artificial-intelligence/10-minute-chats-on-generative-ai)

McTighe, J., & Wiggins, G. (2012). Understanding by design framework. ASCD. [https://files.ascd.org/staticfiles/ascd/pdf/siteASCD/publications/UbD\\_WhitePaper0312.pdf](https://files.ascd.org/staticfiles/ascd/pdf/siteASCD/publications/UbD_WhitePaper0312.pdf)

Mennella, T., & Quadros-Mennella, P. (2024). Student use, performance and perceptions of ChatGPT on college writing assignments. *Journal of University Teaching and Learning Practice*, 21(1). <http://dx.doi.org/10.53761/pgwk1a93>

Moorhouse, B. L., Yeo, M. A., & Wan, Y. (2023). Generative AI tools and assessment: Guidelines of the world's top-ranking universities. *Computers and Education Open*, 5, 100151. <https://doi.org/10.1016/j.caeo.2023.100151>

Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence*, 2, 100041. <https://doi.org/10.1016/j.caai.2021.100041>

Nguyen, A., Ngo, H. N., Hong, Y. et al. (2022). Ethical principles for artificial intelligence in education. *Education and Information Technologies*, 28, 4221–4241. <https://doi.org/10.1007/s10639-022-11316-w>

QAA. (2023, May 8). Maintaining quality and standards in the ChatGPT era: QAA advice on the opportunities and challenges posed by generative artificial intelligence. *Quality Assurance Agency*. [www.qaa.ac.uk/docs/qaa/members/maintaining-quality-and-standards-in-the-chatgpt-era.pdf?sfvrsn=2408aa81\\_10](http://www.qaa.ac.uk/docs/qaa/members/maintaining-quality-and-standards-in-the-chatgpt-era.pdf?sfvrsn=2408aa81_10)

Sheese, B., Liffiton, M., Savelka, J., & Denny, P. (2024, January). Patterns of student help-seeking when using a large language model-powered programming assistant. In *Proceedings of the 26th Australasian Computing Education Conference* (pp. 49–57). <https://doi.org/10.1145/3636243.3636249>

Sullivan, M., McAuley, M., Degiorgio, D., & McLaughlan, P. (2024). Improving students' generative AI literacy: A single workshop can improve confidence and understanding. *Journal of Applied Learning & Teaching*, 7(2), 1–10. <https://doi.org/10.37074/jalt.2024.7.2.7>

UNESCO. (2024). *Ethics of artificial intelligence*. [www.unesco.org/en/artificial-intelligence/recommendation-ethics?hub=99488](http://www.unesco.org/en/artificial-intelligence/recommendation-ethics?hub=99488)

Weber-Wulff, D., Anohina-Naumeca, A., Bjelobaba, S., Foltýnek, T., Guerrero-Dib, J., Popoola, O., Sigut, P., & Waddington, L. (2023). Testing of detection tools for AI-generated text. *International Journal for Educational Integrity*, 19(1), 26. <https://doi.org/10.48550/arXiv.2306.15666>

Wise, B., Emerson, L., Van Luyn, A., Dyson, B., Bjork, C., & Thomas, S. E. (2024). A scholarly dialogue: Writing scholarship, authorship, academic integrity and the challenges of AI. *Higher Education Research & Development*, 43(3), 578–590. <https://doi.org/10.1080/07294360.2023.2280195>

Yan, L., Sha, L., Zhao, L., Li, Y., Martinez-Maldonado, R., Chen, G., ... & Gašević, D. (2023). Practical and ethical challenges of large language models in education: A systematic scoping review. *arXiv*, 133792(2). <https://doi.org/10.48550/arXiv.2303.13379>

Yu, H., & Guo, Y. (2023). Generative artificial intelligence empowers educational reform: Current status, issues, and prospects. *Frontiers in Education*, 8(183162). <https://doi.org/10.3389/feduc.2023.1183162>

# Preparing Pre-Service and In-Service Teachers for the AI-Driven Classroom

11

*Lucas Kohnke, Curtis Green-Eneix*

## Introduction

Teachers curate digital tools and resources and determine the role technology plays in their instruction (Blake, 2013; Kohnke, 2024; Moorhouse & Kohnke, 2024). Accordingly, they have long been able to meaningfully integrate various technologies, such as blackboards, televisions, and computers, into their pedagogy to scaffold and extend students' learning. Recent innovations in generative artificial intelligence (GenAI) and chatbots have captured the imaginations of educators and researchers. The zeitgeist first got excited about AI devices in the 1960s, nicknaming them "teaching machines" (Singer, 2024; Skinner, 1961). While these tools had substantially fewer capabilities than their modern counterparts (Hockly, 2023; Pham & Sampson, 2022), AI tools have consistently led both newcomers and well-established practitioners (Ding et al., 2024; Kohnke et al., 2023a; Moorhouse, 2024a; Moorhouse & Kohnke, 2024; Wang & Cheng, 2021) to pose the question: How can teachers meaningfully integrate these resources into their classrooms without letting them take over?

The latest "teaching machine" to attract attention is ChatGPT ("generative pre-trained transformer"), a GenAI natural language model that

identifies and exploits patterns in its training data to create statistically probable content based on user prompts (Fui-Hoon Nah et al., 2023; Sabzalieva & Valentini, 2023). Research into ChatGPT and similar tools has demonstrated that they can facilitate student learning. GenAI also provides transformative methods to enhance teachers' skills and knowledge (Chan & Colloton, 2024; Chiu et al., 2023). By leveraging these tools, teacher educators can provide more dynamic, personalized learning experiences and equip teachers with the competencies needed in the modern classroom (Moorhouse & Kohnke, 2024). AI can create new content and hands-on activities that allow pre-service teachers to acquire and refine their pedagogical skills (Moorhouse, 2024a) and scaffold learning (e.g. Barrot, 2023; Kohnke et al., 2023b). However, despite their vast potential, these tools have received a mixed reception.

To teach in the classrooms of the future, teachers must be able to use GenAI tools proficiently. This chapter addresses ways to prepare pre-service and in-service teachers to become "generative curators," who thoughtfully amalgamate developed and generated resources. The following sections review recent findings on GenAI and how it supports student learning in multilingual classrooms. They also focus on current suggestions for implementing technological tools and how GenAI is situated within the teacher education literature.

## GenAI in Education

As previously mentioned, AI has been around long before ChatGPT's debut in 2022. It was first seen in education in the 1920s, with Sidney Pressy's assessment machine, which presented learners with multiple-choice questions (Bellamy, 2022). A few decades later, they gained short-lived notoriety with Skinner's (1961) teaching machine, which aimed to automate mathematics learning (Watters, 2021). The limited capabilities and specificity of these early AI tools prevented them from having the same lasting impact on education as contemporary ones. Pham and Sampson (2022) observed that AI was considered "weak" at the time because it could only function and operate within specific tasks and parameters, limiting its application. In contrast, ChatGPT represents an advanced teaching machine that may reshape the educational landscape because it can understand, learn, and apply knowledge.

However, as support, training and literacy are lacking, teachers' engagement with GenAI depends on their familiarity with these tools more than their professional experience (Moorhouse, 2024a). Wang and Cheng (2021) noted that K-12 teachers in Hong Kong are hesitant to use AI tools in their classrooms due to a lack of understanding and confidence. Kohnke et al. (2023b) found that university English language instructors also lacked the digital competencies and understanding of GenAI tools necessary to integrate them into their pedagogy confidently. While both examples illustrate findings in Hong Kong, these results have been echoed in other countries such as Germany (e.g. Zhang et al., 2023), Israel (e.g. Nazaretsky et al., 2022), South Korea (e.g. Kim & Kwon, 2023), and the United States (e.g. Bhutoria, 2022). News outlets have also noted the fears and hesitations of teachers (e.g., Singer, 2024). Therefore, it is necessary to identify effective GenAI integration strategies and help teachers use these tools intentionally to design, curate, and deliver materials tailored to their teaching needs.

## Integrating AI Literacy in Teacher Education

Expanding upon current approaches, professional development is needed to prepare pre- and in-service teachers to become generative curators. As highlighted by Chen et al. (2020), Moorhouse and Kohnke (2024), and Sabzalieva and Valentini (2023), teacher education programs should proactively include AI-specific literacy and competencies to ensure teachers are familiar with them. *Digital literacy* refers to “the practices of communicating, relating, thinking and being associated with digital media” (Jones & Hafner, 2021, p. 17); *AI literacy* can be considered a specific branch. Long and Magerko (2020) defined AI literacy as “a set of competencies that enables individuals to critically evaluate AI technologies; communicate and collaborate effectively with AI; and use AI as a tool online, at home, and in the workplace” (p. 2). Both pre-service and in-service teachers must develop AI literacy and understand it as a digital tool they can tailor to their specific contexts and needs.

To begin integrating AI literacy into teacher education, teacher educators should dispel myths about AI and technology in general. This builds on the work of Blake (2013), who identified common

technological myths: the idea that technology is monolithic, that its inclusion automatically leads to improved learning outcomes or that it jeopardizes learning (Kim & Kwon, 2023; Wang & Cheng, 2021). As Chen et al. (2020) and Ouyang and Jiao (2021) have observed, critical reflection should be a key part of training programs. Teachers and teacher educators should reflect collaboratively on how they envision engaging with AI.

Ouyang and Jiao (2021) argued that three paradigms show how AI can be positioned in teaching. These are (1) *AI-directed*, where the learner-as-recipient receives the knowledge and/or skills they are expected to attain; (2) *AI-supported*, where the learner-as-collaborator works with AI to individualize and optimize the learning process; and (3) *AI-empowered*, where the learner-as-leader views AI as a tool to be augmented and directed with the guidance of the teacher (pp. 2–4). By reflecting on the role of AI, teachers can “meaningfully negotiate human–AI relationship in a way that is meaningful and beneficial for students” (Chen et al., 2020, p. 3). In addition, reflective practice can be deepened with AI-guided self-assessments, which track learners’ progress and identify areas for improvement.

To incorporate critical reflection into discussions, teacher educators can ask the following questions:

- *Pedagogical alignment*: How does AI align with and support the educational goals of the professional development program?
- *Relevance and usability*: How can AI-powered solutions address curricular content and methods for pre-service and in-service teachers?
- *Learning outcomes*: How can AI enhance the assessment of competencies and contribute to measurable improvements in teaching?

These questions are initial starting points for teachers (pre- or in-service) and teacher educators. They provide an essential space for considering how AI-powered solutions can meet their future needs. The primary focus should be giving teachers the skills and knowledge necessary to thrive in the profession (Moorhouse, 2024a; Moorhouse et al., 2024). Considering these questions will ensure that AI integration is connected to the core objectives of teacher education. Furthermore, to pursue a comprehensive strategy, teacher educators may also consider the following supplemental questions:

- *Teacher readiness*: Are teachers prepared to incorporate AI into their practices? How can professional development help them do so?
- *Student impact*: How do AI tools influence students' learning experiences?
- *Technological infrastructure*: Do schools have the infrastructure necessary to integrate AI? How do they manage data privacy and security?

These questions can help provide a more holistic understanding of the factors contributing to successful AI integration, thereby ensuring that teachers choose the right tools and consider their implications for the broader educational ecosystem.

### *Practical Strategies for Integrating AI in Teacher Education*

AI offers teachers opportunities to gain pedagogical skills and refine their craft. It can also provide personalized feedback on teaching strategies by analyzing lesson recordings, thereby fostering professional growth (Nazaretsky et al., 2022). To harness the full potential of AI, teachers can also generate personalized materials that reinforce core concepts and make study sessions more productive (Chen et al., 2020). Effective AI integration is intuitive, translates complex educational concepts into digestible knowledge, and offers immediate, actionable insights. Like other emerging technologies that bring education into daily life, AI adds sophisticated tools to teachers' repertoires to help them improve and adapt (Kohnke & Zou, in-press).

The following questions should be considered when integrating AI:

1. *Pedagogy*: What specific skills or knowledge do teachers need?
2. *Learning aims*: What specific skills or knowledge should students gain?
3. *Role of AI*: How can AI help teachers achieve these educational goals?
4. *Form of AI*: What AI tools or resources will best serve the learning objectives?

While addressing these questions, it is important to focus on four essential features: (1) learners' needs, (2) the medium, (3) interactivity, and (4) simplicity. The purpose of integrating AI is to supplement the

human element of teaching, not replace it. By carefully structuring programs to meet the needs of teachers, teacher educators can prepare them for the dynamic, modern classroom.

## Learners' Needs

Due to their rapid expansion, GenAI tools (e.g. ChatGPT, Midjourney, Canva's "Magic" features) are quickly becoming an integral part of students' lives and transforming how they work, learn and communicate. This rapid technological advancement highlights the importance of integrating AI into teacher education to ensure all teachers can meet the evolving needs of students (Moorhouse, 2024a).

As AI reshapes education, it is also important to consider the specific needs of those who are learning how to harness it. This includes pre- and in-service teachers. Pre-service teachers, who are still developing their pedagogical skills, require a solid foundation in AI literacy and its educational applications (Yang & Chen, 2023). They need to understand how to create engaging and personalized learning experiences and how to critically evaluate and select appropriate tools for their future classrooms (Lee & Kwon, 2024). By incorporating AI into pre-service teacher training programs, it is possible to ensure that the next generation of educators is prepared to maximize the potential of AI in education from the start of their careers.

In-service teachers, however, face different challenges as they integrate AI into their established teaching practices. They need professional development focused on practical strategies (Zhang et al., 2023). They also require support in developing their AI literacy skills and guidance on how to use AI to differentiate instruction and meet the diverse needs of their students.

Moreover, all teachers must be equipped to address the ethical implications of AI in education (Hockly, 2023). As the technology becomes more prevalent, teachers will have to navigate issues related to data privacy, algorithmic bias and responsible usage (Chan, 2023). They will also need to critically evaluate the potential benefits and risks of AI and make informed decisions to promote equity and inclusion.

AI has the potential to enhance education, support teachers and offer personalized learning opportunities (Kohnke et al., 2023a; Kohnke &

Zou, in-press). However, to maximize its benefits, the unique needs of both pre-service and in-service teachers must be considered. By providing teachers with the knowledge, strategies, and support needed to implement AI effectively, teacher educators can ensure that this powerful technology is leveraged to improve outcomes and streamline everyday processes.

## The Medium

When selecting the appropriate medium for AI learning experiences, teacher educators should consider the specific actions to take before, during and after the training. While video is often preferred because it can combine slides, audio and graphics, other forms of media can also be effective. Some examples include interactive infographics, simulations, and PDFs. Focusing on alternative media will allow teacher educators to facilitate collaborative discussions about the diverse semiotic resources, languages, and communicative practices associated with each. This approach creates learning opportunities for teachers and helps them develop digital literacy (Jones & Hafner, 2021).

For example, infographics can help language learners develop content-related vocabulary or promote the acquisition of knowledge in a STEM field such as biology. The teacher educator can demonstrate to in-service biology teachers how students can collaboratively develop an infographic focused on one of the seven biological kingdoms. As they illustrate this, they can showcase how AI-generated visual aids can enhance students' comprehension and retention of complex theories and practices (Chiu, 2023). AI can also help teachers focus on specific learning outcomes by breaking down the curriculum into manageable learning objectives.

## Interactivity

Because participant interaction and engagement are crucial components of any professional development program, various interactive features that appeal to different learning styles and preferences should be embedded. AI can be leveraged to create and integrate

these interactive elements seamlessly. For example, AI tools can generate single and/or multiple-choice questions, dropdown lists, fill-in-the-blank events, or click-and-reveal exercises. AI can also be used to develop interactive review activities using digital flashcards or short social media reflections on platforms like Padlet, Kahoot, Mentimeter, or Lino (Kohnke & Moorhouse, 2021; Moorhouse & Kohnke, 2020). Furthermore, AI can develop realistic simulations and role-playing exercises that provide hands-on classroom management experience without the immediate pressure and risk of working with actual students (Ding et al., 2024). These AI-generated interactive features can enhance the learning experience and provide personalized feedback.

### Simplicity

Another essential consideration is simplicity. The key is to keep the training session straightforward, sequential and focused on a single fundamental premise or concept. Teacher educators must consider their intended audience (i.e., pre-service or in-service teachers) and the best way to present information without diluting it. For example, they may demonstrate how to plan a lesson with Khanmigo ([khanmigo.ai](https://khanmigo.ai)) that supports instructional objectives and course goals.

By adopting an AI-empowered stance (Ouyang & Jiao, 2021), teacher educators can scaffold and enhance pre-service teachers' existing AI literacy. This approach allows pre-service teachers to critically engage with AI tools, ultimately choosing whether they want to adapt or reject them. Teacher educators should focus on modeling the ethical, pedagogical, and critical use of GenAI tools to ensure that pre-service teachers can work with them competently (Moorhouse & Kohnke, 2024).

In-service teachers need the opportunity to experiment with GenAI, to develop pedagogical and content knowledge (Mishra et al., 2023). Teacher educators can advise in-service teachers about integrating these tools into their existing practices. They can develop materials, class activities, and homework assignments that include GenAI. This can showcase how to position AI as a collaborator.

As the program advances, the content can become more complex and show how GenAI can be seamlessly integrated into various aspects

of teaching rather than being limited to a single activity. In addition, technology (GenAI or otherwise) “can be harnessed to assist humans in carrying out certain activities without implying any particular hierarchical ranking” (Blake, 2013, p. 110). In other words, both teachers need guided practice engaging with and reflecting on GenAI tools and digital resources to understand when they will be appropriate and helpful. Accordingly, teacher educators should highlight that AI integration is not a one-size-fits-all strategy; it is not suitable for all content. However, with careful planning and effective strategies, AI-augmented learning experiences can augment the teaching practices, capabilities and skills of both seasoned and novice teachers (Ding et al., 2024; Kim & Kwon, 2023). The following section explores the impact of specific AI tools and applications that can enrich, enhance, and optimize the learning experiences of pre- and in-service teachers.

## AI Tools and Software

Teachers who are expected to integrate AI tools into their practices must understand their capabilities and applications. This section provides an overview of some of the most popular tools currently available to meet educational needs.

### Content/Text

- OpenAI’s ChatGPT-3.5 (free) and ChatGPT-4o (subscription) generate text based on user prompts. In educational settings, these programs are particularly useful for crafting detailed explanations, generating creative writing prompts, or adapting complex texts for students at different proficiency levels. ChatGPT-4o integrates voice, vision, and text within a unified model. It can respond to text, images, and audio in milliseconds, which is similar to the speed of human conversation. This adds a versatile tool to teachers’ digital arsenals. OpenAI has also introduced ChatGPT Edu so universities can provide AI access to students, faculty, researchers, and campus operations responsibly. It is powered by ChatGPT-4o, supports text and visuals, uses advanced data analysis tools, builds GPTs, supports over 50 languages, and has robust security features (OpenAI,

n.d.). Some of the projected advancements coming in ChatGPT 5 include enhanced multimodal capabilities and potential agent-like autonomy, which can revolutionize human–computer interactions.

- Microsoft’s Copilot can assist with creating content, summarizing information, and answering questions. It is especially beneficial for teachers who are planning lessons, preparing materials and creating assessments based on up-to-date information. Copilot for Microsoft 365 allows teachers to connect and manage their data, including their chats, documents, meetings, and emails. They can use Copilot in SharePoint or the new planned “Catch UP” chat interface. While Copilot is built using OpenAI’s ChatGPT models, all data are processed by Microsoft and not used to train the underlying large language models. In addition, Microsoft Copilot allows administrators to set up role-based access control, ensuring that only authorized users can access specific features and data based on their roles and responsibilities. Some advancements coming to Microsoft Copilot include enhanced natural language processing capabilities, improved integration with all Microsoft software and advanced analytics to help educators track students’ progress and identify areas for improvement.
- Google’s Gemini excels at processing prompts, producing text and generating multimedia content. It is a valuable resource for engaging students by creating visually enriching educational materials and interactive learning experiences. While Google has not released detailed information about the specific features coming to Gemini in the future, the company has expressed its commitment to continuously improving its capabilities. Future versions could include enhanced multimodal processing, improved contextual understanding and better integration with educational tools like Google Classroom and Docs.
- Perplexity.ai stands out by not only answering questions but also providing citations from web sources, making it useful for research and verification. Its ability to generate images and videos (in the “pro” version) makes it ideal for enhancing multimedia presentations in the classroom. In the future, there will be a feature called “Perplexity Pages,” which will produce a draft article or webpage (with editable sources) on a topic chosen by the user.
- Diffit.me is specifically designed for use in education. It enables teachers to quickly adapt content to suit various reading levels. They can also create custom texts, quizzes, and activities by selecting the

desired reading level and language. The platform supports formats such as PDFs, PowerPoints, and Word documents, facilitating various teaching methods and styles. Future features will likely include enhanced AI suggestions for customization and enhanced integration with educational platforms.

These tools can customize learning materials, facilitate the integration of multimedia resources and support diverse learning needs by adjusting complexity. By incorporating them into their teaching practices, educators can save time and enrich their students' learning experiences significantly.

### *Visual: Images and Arts*

- OpenAI's DALL-E2 and DALL-E3 are similar to ChatGPT but specifically designed for image generation. They create distinct images in response to prompts. This feature allows educators to select the most suitable image for their material, enhancing visual learning and engagement in the classroom. Future advancements will include the capability to understand more nuance and details in user prompts, allowing teachers to easily translate their ideas into accurate images and further enriching the educational experience.
- Sora by OpenAI specializes in creating realistic and imaginative videos based on text instructions. It is handy for creating dynamic content that captures students' attention and explains complex concepts using visual storytelling. Future versions of Sora will have enhanced capabilities to generate videos that cater to different learning styles, preferences, and paces while nurturing creativity and imagination.
- Adobe's Firefly uses simple prompts in over 100 languages to transform text into creative images. It benefits teachers who need high-quality stock images for their teaching activities. It can produce custom visuals that are tailored to classroom demographics in terms of culture and language, enhancing inclusivity. Looking ahead, Firefly will include text-based video editing, 3D-scheme to image generation and dynamic element repositioning.
- Midjourney allows users to create high-quality images using simple text prompts. It is versatile, making it suitable for projects that

require unique or precise visual content. Teachers can generate visuals that complement lesson themes, project ideas, or student-driven inquiries. In the future, Midjourney will likely be capable of processing and interpreting increasingly nuanced and complex descriptions with improved image resolution.

By integrating tailored images and videos into the curriculum, educators can provide rich, engaging learning experiences. These tools foster creativity and cater to visual learning styles, making complex subjects accessible and understandable.

## *Productivity*

- Futurepedia is a comprehensive, free resource that categorizes AI tools by functionality, including those focused on writing assistance, image generation, and video editing. This platform is especially useful for teachers who need a starting point to enhance the multi-media aspects of their lessons or streamline the lesson creation process. Futurepedia is expected to expand its offerings by embedding advanced personalization features and deeper integration with popular educational platforms, further empowering teachers to create dynamic and engaging lessons.
- Magicschool.ai was designed explicitly with educators in mind and provides a suite of AI tools tailored to enhance the workflow of teaching. These tools can generate lesson plans, rubrics, automated feedback, and class newsletters. It can save teachers time and reduce their workload, as well as build AI literacy among educators and students alike. In addition, each tool includes an AI coach called Raina with whom teachers can collaborate and discuss their output. Coming advancements include a custom tools dashboard and more export options (e.g. PDF, Google Suite, Microsoft Word).
- Mylessonpal is an intuitive platform for teachers focused on creating, sharing, and collaborating on educational resources. It includes tools for designing worksheets, projects and quizzes, as well as features that encourage teachers to work together. Therefore, it increases the variety and quality of classroom materials. Looking ahead, Mylessonpal will likely continue to evolve by integrating more advanced AI-driven tools, virtual collaboration spaces and

enhanced analytics to further support teachers in creating high-quality educational content.

- Gamma offers a user-friendly interface and allows teachers to automatically generate engaging websites, presentations, and documents. Teachers simply input a topic and the tool creates professional, visually appealing instructional materials that enhance student engagement and comprehension. In the future, Gamma will likely introduce more AI-driven features, such as enhanced customization options, real-time collaborative editing, and deeper integration with learning management systems.

By incorporating these AI tools into their practices, educators can significantly enhance their productivity and the learning experiences they provide, while preparing their students for the technologically advanced future.

## Best Practices

AI can revitalize both teacher preparation and professional development programs (Ding et al., 2024). It can provide pre-service and in-service teachers with the skills and knowledge they need by delivering personalized, targeted content directly to their mobile devices. Accordingly, teachers can access and complete training sessions when it is convenient: during their commutes, breaks, or free time.

While AI training is often an isolated event, it can also be one part of a more extensive learning experience. If designed appropriately, it can lead to greater levels of flexibility, engagement, and productivity (Gillani et al., 2023). Due to the prevalence of AI tools, integrating them into teacher education prepares them for the future. The following five tips can optimize AI training programs and create AI-ready teachers:

1. *Focus on individual needs:* Use AI to personalize learning experiences and curate content that addresses specific skill gaps, learning preferences and career goals. Individual learning pathways help teachers focus on the most relevant material, making training sessions more efficient and effective.
2. *Optimize mobility:* Design “bite-sized” learning modules that can easily be consumed on small screens during short periods, such

as commutes or breaks. Responsive design and mobile-optimized interfaces help create seamless learning experiences.

3. *Integrate into daily life:* Encourage teachers to incorporate AI learning into their daily routines. This may involve setting reminders or scheduling specific times for learning (e.g. free or low-intensity periods). This promotes consistent engagement.
4. *Blend with larger learning experiences:* Combine AI learning modules with in-person workshops, webinars, and collaborative projects to create holistic learning environments that foster community and peer-to-peer sharing.
5. *Promote engagement through flexibility:* Ensure that AI learning allows users to start, stop, and resume learning activities as needed.

By implementing these tips, teacher educators can prepare teachers for the future, respect their time, and adapt to their evolving needs.

## Summary

Teachers who are prepared for the AI-driven classroom can enhance learning experiences and personalize education for students. This chapter explores practical strategies for integrating AI into teacher education programs, emphasizing the importance of considering learners' needs, the medium, interactivity, and simplicity, as well as identifying best practices for creating AI-ready teachers.

The rapid increase of GenAI tools in education highlights the importance of integrating AI education into the curriculum to meet the evolving needs of learners. Pre-service teachers require a solid foundation in AI tools and their applications, while in-service teachers need practical strategies for incorporating AI tools into existing curricula and classroom routines. Both groups need to develop the knowledge and skills to address the ethical implications of AI.

When selecting the appropriate medium for AI learning experiences, teacher educators should consider the relevance of the topic, interactivity, engagement, and simplicity. AI integration requires careful planning and appropriate strategies. When implemented thoughtfully, AI-augmented learning experiences can complement and enhance teachers' practices and skills. In addition, best practices include focusing on individual needs, optimizing mobility, integrating AI

training into daily life, blending AI learning modules with extensive learning experiences, and promoting engagement through flexibility.

When teachers are provided with the knowledge, strategies, and support they need to use AI in the classroom effectively, they are prepared to teach in the modern classroom. AI can enhance education, support teachers and offer students more personalized learning experiences, ultimately preparing them for the future.

## Discussion Questions

1. How can you align AI tools and strategies with the learning outcomes of your teacher education program?
2. What specific skills and knowledge do pre-service and in-service teachers need to use AI in their classrooms effectively? How can they be incorporated into your curriculum?
3. How can you ensure that the AI tools and resources you select are pedagogically appropriate and useful for pre-service and in-service teachers?
4. What challenges will you face in integrating AI into your teacher education program? How can you address them proactively?
5. How can you foster a culture of continuous learning and professional development to help teachers stay up-to-date with the latest AI tools and strategies in education?

## References

Barrot, J. S. (2023). Using automated written corrective feedback in the writing classrooms: Effects on L2 writing accuracy. *Computer Assisted Language Learning*, 36(4), 584–607. <https://doi.org/10.1080/09588221.2021.1936071>

Bellamy, T. (2022). *A brief history of LMS*. <https://mylearninghub.com/blog/post/history-of-lms>

Bhutoria, A. (2022). Personalized education and artificial intelligence in the United States, China, and India: A systematic review using a Human-In-The-Loop model. *Computers and Education: Artificial Intelligence*, 3, 100068. <https://doi.org/10.1016/j.caeari.2022.100068>

Blake, R. J. (2013). *Brave new digital classroom: Technology and foreign language learning* (2nd ed.n). Georgetown University Press.

Chan, C. K. Y. (2023). A comprehensive AI policy education framework for university teaching and learning. *International Journal of Educational Technology in Higher Education*, 20(38). <https://doi.org/10.1186/s41239-023-00408-3>

Chan, C. K. Y., & Colloton, T. (2024). *Generative AI in higher education: The ChatGPT effect*. Routledge.

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access*, 8, 75264–75278. <https://doi.org/10.1109/ACCESS.2020.2988510>

Chiu, K. F. T. (2023). The impact of generative AI (GenAI) on practices, policies and research direction in education: A case of ChatGPT and Midjourney. *Interactive Learning Environment*. <https://doi.org/10.1080/10494820.2023.2253861>

Chiu, K. F. T., Xia, Q., Zhou, Z., Chai, C. S., & Cheng, M. (2023). Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education. *Computers and Education: Artificial Intelligence*, 4, 100118. <https://doi.org/10.1016/j.caeari.2022.100118>

Ding, A.-C. E., Shi, L., Yang, H., & Cho, I. (2024). Enhancing teacher AI literacy and integration through different types of cases in teacher professional development. *Computers and Education Open*, 100178. <https://doi.org/10.1016/j.caeo.2024.100178>

Fui-Hoon Nah, F., Zheng, R., Cai, J., Siau, K., & Chen, L. (2023). Generative AI and ChatGPT: Applications, challenges, and AI-human collaboration. *Journal of Information Technology Case and Application Research*, 25(3), 277–304. <https://doi.org/10.1080/15228053.2023.2233814>

Gillani, N., Eynon, R., Chiabaut, C., & Finkel, K. (2023). Unpacking the “black box” of AI in education. *Educational Technology & Society*, 26(1), 99–111. [https://doi.org/10.30191/ETS.202301\\_26\(1\).0008](https://doi.org/10.30191/ETS.202301_26(1).0008)

Hockly, N. (2023). Artificial intelligence in English language teaching: The good, the bad, and the ugly. *RELC Journal*, 54(2), 445–451. <https://doi.org/10.1177/00336882231168504>

Jones, R. H., & Hafner, C. A. (2021). *Understanding digital literacies: A practical introduction*. Routledge.

Kim, K., & Kwon, K. (2023). Exploring the AI competencies of elementary school teachers in South Korea. *Computers and Education: Artificial Intelligence*, 4, 100137, <https://doi.org/10.1016/j.caeari.2023.100137>

Kohnke, L. (2024). Navigating the digital turn: recent books on technological integration in ELT (survey review). *ELT Journal*, 78(2), 216–233. <https://doi.org/10.1093/elt/caae014>

Kohnke, L., & Moorhouse, B. L. (2021). Using Kahoot! to gamify learning in the language classroom. *RELC Journal*, 53(3), 769–775. <https://doi.org/10.1177/00336882211040270>

Kohnke, L., Moorhouse, B. L., & Zou, D. (2023a). ChatGPT for language teaching and learning. *RELC Journal*, 54(2), 537–550. <https://doi.org/10.1177/00336882231162868>

Kohnke, L., Moorhouse, B. L., & Zou, D. (2023b). Exploring generative artificial intelligence preparedness among university language instructors: A case study. *Computer and Education: Artificial Intelligence*, 5, 100156. <https://doi.org/10.1016/j.caeari.2023.100156>

Kohnke, L., & Zou, D. (in-press). The role of ChatGPT in enhancing English teaching: A paradigm shift in lesson planning and instructional practices. *Educational Technology & Society*.

Lee, S. J., & Kwon, K. (2024). A systematic review of AI in education in K-12 classrooms from 2018 to 2023: Topics, strategies, and learning outcomes. *Computers and Education: Artificial Intelligence*, 6, 100211. <https://doi.org/10.1016/j.caeari.2024.100211>

Long, D., & Magerko, B. (2020). What is AI literacy? Competencies and design considerations. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1–16). <https://doi.org/10.1145/3313831.3376727>

Mishra, P., Warr, M., & Islam, R. (2023). TPACK in the age of ChatGPT and generative AI. *Journal of Digital Learning in Teacher Education*, 39(4), 235–251. <https://doi.org/10.1080/21532974.2023.2247480>

Moorhouse, B. L. (2024a). Beginning and first-year language teachers' readiness for the generative AI age. *Computers and Education: Artificial Intelligence*, 6, 100201. <https://doi.org/10.1016/j.caeari.2024.100201>

Moorhouse, B. L. (2024b). Generative artificial intelligence in ELT. *ELT Journal*. <https://doi.org/10.1093/elt/cca032>

Moorhouse, B. L., & Kohnke, L. (2020). Using Mentimeter to elicit student responses in the EAP/ESP classroom. *RELC Journal*, 51(1), 198–204. <https://doi.org/10.1177/0033688219890350>

Moorhouse, B. L., & Kohnke, L. (2024). The effects of generative AI on initial language teacher education: The perceptions of teacher educators. *System*, 122, 103290, <https://doi.org/10.1016/j.system.2024.103290>

Moorhouse, B. L., Wan, Y., Wu, C., Kohnke, L., Ho., T. Y., & Kwong, T. (2024). Developing language teachers' professional generative AI competence: An intervention study in an initial language teacher education course. *System*, 125, 103399. <https://doi.org/10.1016/j.system.2024.103399>

Nazaretsky, T., Ariely, M., Cukurova, M., & Alexandron, G. (2022). Teachers' trust in AI-powered educational technology and a professional development program to improve it. *British Journal of Educational Technology*, 53(4), 914–931. <https://doi.org/10.1111/bjet.13232>

OpenAI. (n.d.). Introducing ChatGPT Edu. <https://openai.com/index/introducing-chatgpt-edu/>

Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education: Artificial Intelligence*, 2, e100020. <https://doi.org/10.1016/j.caeai.2021.100020>

Pham, S. T. H., & Sampson, P. M. (2022). The development of artificial intelligence in education: A review in context. *Journal of Computer Assisted Learning*, 38, 1408–1421. <https://doi.org/10.1111/jcal.12687>

Sabzalieva, E., & Valentini, A. (2023). *ChatGPT and artificial intelligence in higher education: Quick start guide*. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf000385146>

Singer, N. (2024, January 11). Will chatbots teach your children? New AI tools could enable a Silicon Valley dream: bots that customize learning for pupils. *The New York Times*. [www.nytimes.com/2024/01/11/technology/ai-chatbots-khan-education-tutoring.html](http://www.nytimes.com/2024/01/11/technology/ai-chatbots-khan-education-tutoring.html)

Skinner, B. F. (1961). Teaching machines. *Scientific American*, 205(5), 90–106. [www.jstor.org/stable/24937132](http://www.jstor.org/stable/24937132)

Wang, T., & Cheng, E. C. K. (2021). An investigation of barriers to Hong Kong K-12 schools incorporating artificial intelligence in education. *Computers and Education: Artificial Intelligence*, 2, e100031. <https://doi.org/10.1016/j.caeai.2021.100031>

Watters, A. (2021). *Teaching machines: The history of personalized learning*. The MIT Press.

Yang, T. C., & Chen, J. H. (2023). Pre-service teachers' perceptions and intentions regarding the use of chatbot through statistical and lag sequential analysis. *Computers and Education: Artificial Intelligence*, 4, 100119. <https://doi.org/10.1016/j.caeai.2022.100119>

Zhang, C., Schießl, J., Plößl, L., Hofmann, F., & Gläser-Zikuda, M. (2023). Acceptance of artificial intelligence among pre-service teachers: A multigroup analysis. *International Journal of Educational Technology in Higher Education*, 20(49). <https://doi.org/10.1186/s41239-023-00420-7>

# Preparing Students to Live and Work in an AI-Driven World: Ideas for Educators and Students

12

*Laura Dumin*

## Introduction

You probably don't think of *Schitt's Creek* and the modified Kübler-Ross *Change Curve Model*, better known as the five stages of grief—denial, anger, bargaining, depression, and acceptance (WebMD, n.d.)—when considering Artificial Intelligence (AI) and the writing classroom. While a popular TV show and a model of emotional change first developed in 1969 might seem light-years apart, there are several parallels within these seemingly far-flung concepts.

The show starts when a business partner steals the Rose family's money, leaving them without possessions or a home. They are left destitute; with only the few bags they were able to pack before being evicted. John, the father, recalls buying the small town of Schitt's Creek as a joke, so they decide to move there, ending up in a rundown motel with two adjoining rooms—a stark downgrade from the mansion they had been living in just days before. The worst part is that they have to rely on the mayor to comp their rooms because they have no money.

At this point, one might question the relevance of this scenario to AI and the preparation of students for future challenges. To address this, it seems worthwhile to spend some time thinking about the modified *Kübler-Ross Change Curve Model* along with the *Technology Acceptance Model (TAM)*. By viewing these models through the lens of pop culture, we can better understand some of the changes that AI has brought to higher education.

The modified *Kübler-Ross Change Curve Model* includes seven non-linear stages: (1) Shock, (2) Denial, (3) Frustration, (4) Depression, (5) Experiment, (6) Decision, and (7) Integration. This model is sometimes referred to more commonly as the “grief cycle” or the “stages of grief.” People may move back and forth through the stages or skip stages depending on their response to a situation.

The *TAM*, first presented in 1989, looks at “how well a technology ‘fits’ with user tasks” (Rahimi et al., 2018, p. 605). Developed by Fred Davis (1989), the *TAM* posits that two primary factors influence an individual’s intention to use a technology:

1. **Perceived Usefulness:** The degree to which a person believes that using a particular technology would enhance their job performance or help them achieve their goals (Davis, 1989). For example, a farmer might consider how useful a new crop monitoring app would be for improving yields (Enablers of Change, 2023).
2. **Perceived Ease of Use:** The extent to which a person believes that using a specific technology would be free from effort (Davis, 1989). For instance, how easy a user thinks it would be to learn and operate a new software application (Enablers of Change, 2023).

According to the *TAM*, these two factors directly influence a user’s attitude toward using the technology, which in turn affects their behavioral intention to use it. Ultimately, this behavioral intention leads to actual system use. The model can be summarized as follows:

1. External variables influence perceived usefulness and perceived ease of use.
2. Perceived ease of use also affects perceived usefulness.
3. Both perceived usefulness and perceived ease of use shape the attitude toward using the technology.
4. Perceived usefulness directly influences behavioral intention to use.

5. Attitude toward using and behavioral intention determine actual system use (Marikyan & Papagiannidis, 2023).

Over time, the *TAM* has been expanded and refined. By focusing on perceived usefulness and ease of use, the *TAM* provides a practical framework for understanding and promoting technology adoption across various contexts.

For many educators, November 30, 2022, turned our worlds upside-down through no actions of our own, much like the Rose family. OpenAI released ChatGPT 3.0 publicly, leaving us to deal with the aftermath. We had no advanced warning and no way to prepare for this seismic shift in education. By mid-December 2022, like many educators, I had moved from the *shock* to the *frustration* and *depression* stages of the modified *Kübler-Ross Change Curve Model*, mostly bypassing *denial* altogether. I received a student paper that I strongly suspected had been written by AI and I was (1) angry, feeling taken advantage of, and (2) depressed, feeling like there was no way to stop this. I sat in anger and depression for a few weeks before a colleague made a comment wondering if there was a way to utilize this new AI thing in our teaching, rather than surrender to what seemed like an inevitable replacement of our jobs. And just like that, I transitioned to the *experimentation* stage of the modified *Kübler-Ross Change Curve Model*.

Since late December 2022, I have remained in this stage while also engaging in the *integration* stage of the modified *Kübler-Ross Change Curve Model*. During this time, I have been contemplating how AI can be employed ethically, responsibly, and transparently in my teaching, ensuring that students continue to receive a quality education. Reflecting on the Rose family, their emotional evolution closely mirrors what I have observed in numerous conversations with faculty since January 2023. Faculty began feeling lost and angry about their situation, with many initially refusing to accept their new reality. The Roses maintained the hope that external salvation was always just around the corner, which seemed to be where many educators stayed at first. When that salvation was yanked away from them, the Roses moved to the *frustration* and *depression* stages, where many educators lived in spring 2023.

Educators were aware of AI's presence, but many felt unprepared to address the issue. As a result, they resigned themselves to the fact that students would use it, leading to frustration. From there, some educators

realized that resignation wasn't the best space to be in—students were using AI in less-than-optimal ways and educators needed to make a shift. We began to observe a shift in tolerance among some groups using AI, such as educators and workers, but not always students. However, this did not lead to a widespread embrace of AI tools. In many fields, that tolerance has moved toward more acceptance of AI technologies and an embrace of incremental changes to keep education, knowledge, and learning relevant in the new world order. Educators have found communities where they can learn and grow to meaningfully implement AI in their classrooms without compromising their student learning outcomes. But what happens if you haven't made it through all the stages of grief? How can you advance and help your students do the same while grappling with the significant and valid emotions brought about by the changes AI has introduced to higher education? This chapter explores methods for equipping students with the skills and knowledge necessary to thrive in an AI-driven world, while also acknowledging that educators are at various stages of adapting to these advancements. It will also provide practical strategies for educators to integrate AI technologies into the classroom to prepare students for future career paths. With any luck, by the end of the chapter, you will have gained some ideas for what might work for you.

## Preparing Students for an AI-Dominated Future

Before we can discuss our attitudes toward using AI, it would be beneficial to take a moment to reflect on where we are in our own AI learning and implementation journey. Leon Furze's (2023b) *AI Assessment Scale* (AIAS) can serve as a starting point for evaluating our AI comfort-level, which may be situational. Furze's AIAS is a practical tool designed to help educators integrate generative artificial intelligence (GenAI) into educational assessments in an ethical and pedagogically sound manner (Furze, 2023b). The scale provides a framework for educators to determine appropriate levels of AI usage in assessments based on specific learning outcomes. The AIAS consists of five levels:

- **No AI:** This level prohibits any use of AI tools in the assessment.
- **Limited AI:** Allows for restricted use of AI, typically for specific purposes like idea generation or editing.

- **Partial AI:** Permits more extensive use of AI, but with clear guidelines on what aspects of the work must be original.
- **Mostly AI:** Encourages significant AI usage, with students focusing on critical evaluation and refinement of AI-generated content.
- **Full AI:** Allows unrestricted use of AI, with emphasis on students' ability to effectively prompt, curate, and synthesize AI-generated content (Furze, 2023b).

Drawing from numerous discussions with faculty members, I suggest incorporating an additional dimension to evaluate faculty's AI comfort levels. This aspect has been consistently popular in various talks I've given, highlighting its importance to educators in the field.

- **Situational AI Use:** Allows AI on some assignments and not on others.

Key features of the *AIAS* include (Furze, 2023b):

- **Flexibility:** The scale can be adapted to various educational contexts, from K-12 to higher education.
- **Transparency:** It provides clear guidelines for both educators and students on acceptable AI use in assessments.
- **Ethical integration:** The *AIAS* aims to balance the opportunities presented by GenAI with the need to maintain academic integrity.
- **Shifting focus:** Rather than viewing AI solely as a potential cheating tool, the scale encourages educators to consider how AI can enhance teaching and learning.

The *AIAS* has gained traction globally, with educators in various countries adapting it to their specific needs. By using the *AIAS*, educators can move beyond binary yes/no decisions about AI use in assessments and instead create nuanced, context-specific guidelines that support learning objectives while embracing the potential of AI technology in education. For example, I noted my in addition of the concept of "situational AI use" that it may be appropriate for students to implement AI in one part of an assignment, but not in another. Alternatively, if content is foundational to a student's major, AI might be deemed inappropriate for completing homework assignments but could be utilized to assist in the creation of study guides. Determining

where an assessment task should fall on this scale can help us figure out what steps we might take to move us further through the modified *Kübler-Ross Change Curve Model* and the TAM. Table 12.1 presents the five levels of Furze's AIAS with descriptions and examples of assessment tasks.

TABLE 12.1 AI Assessment Scale from Leon Furze (2023a)

Scale Level	Description	Examples of Assessment Tasks
1. No AI	The assessment is completed under supervision, and/or handwritten, and/or under exam conditions.	Students: <ul style="list-style-type: none"><li>complete a traditional multiple-choice exam on historical events.</li><li>write an in-class essay about the impact of technology on society without the use of AI tools.</li><li>solve a series of math problems on paper during a timed examination.</li></ul>
2. Brainstorming & ideas	AI can be used in the initial stages of the assessment for brainstorming and idea generation.	Students: <ul style="list-style-type: none"><li>use AI to generate ideas for a persuasive essay on the advantages and disadvantages of social media.</li><li>use AI tools to brainstorm potential solutions to an environmental problem in a group project.</li><li>collaborate with AI to develop innovative business ideas for a mock start-up pitch competition.</li></ul>
3. Outlining & notes	AI can be used to outline entire responses or convert notes into organized ideas.	Students: <ul style="list-style-type: none"><li>use AI tools to create an essay outline on the factors contributing to climate change based on their research notes.</li><li>use AI to convert their handwritten notes on a novel into a structured analytical essay outline.</li><li>use AI to organize their research findings on public health policies into a clear presentation outline.</li></ul>

TABLE 12.1 (Cont.)

Scale Level	Description	Examples of Assessment Tasks
4. Feedback & editing	AI can be used to provide feedback, self-assessment, or editing and revision.	Students: <ul style="list-style-type: none"><li>submit their draft essays on the ethical implications of genetic engineering to AI for feedback on structure, clarity, and persuasiveness.</li><li>use AI tools to receive instant feedback on their oral presentations and improve their delivery.</li><li>collaborate with AI to revise and edit their group research papers on the effects of globalization on local economies.</li></ul>
5. Full AI	AI can be used to generate the entire output.	<ul style="list-style-type: none"><li>provide AI with their research and ideas, then use AI-generated synthesis to create a comprehensive report on the future of renewable energy.</li><li>input their group discussion notes on the challenges of urban planning into AI to generate a comprehensive summary.</li><li>supply AI with their concepts and requirements to generate a visual representation of a proposed architectural project.</li></ul>

As we consider what our students will need post-graduation, so many things are unknown to us right now. How much is AI going to disrupt the traditional workplace? How many of the jobs students are preparing for will either disappear or undergo significant changes? How do we know which direction to take as we do our best to imagine this new world? One of the keys to answering these questions is to balance theoretical knowledge with practical application of new skills, in turn encouraging critical thinking and promoting adaptability. Another key aspect is developing a general understanding of how AI is currently impacting our fields and its usefulness both in academia and for our students after graduation. By integrating key concepts related to AI's role and applications, we not only prepare students for the current job market but also equip them with the skills to navigate the ever-evolving nature of AI and technology in the future.

The variety of AI tools available to students is diverse and rapidly expanding. Large language models (LLMs) like ChatGPT, Claude, Copilot, and Gemini offer broad assistance, while specialized research and synopsis tools such as Perplexity, Typeset.io, Research Rabbit, Elicit, Undermind, and Connected Papers facilitate research and information comprehension. Additionally, image generation platforms like Midjourney and Adobe Firefly enable visual content creation with minimal input. This proliferation of AI resources presents two major challenges for faculty: they need to learn how to use unfamiliar tools themselves, and they must teach students how to use these technologies responsibly, ethically, and transparently. The breadth and depth of this technological shift can be daunting for instructors as they navigate this new educational terrain.

## Bridging Emotional Adaptation and AI Acceptance in Education

This section explores the impact of AI on educators and learners, examining a range of issues through the dual lenses of the *Kübler-Ross Change Curve* and the *Technology Acceptance Model*. By blending the emotional and psychological stages of the Kübler-Ross model with the practical considerations of technology acceptance outlined in TAM, it offers a thorough exploration of how stakeholders navigate AI's challenges and opportunities. Key themes such as foundational understanding, hands-on experience, interdisciplinary learning, critical thinking, communication skills, ethical implications, adaptability, and lifelong learning are explored, alongside practical strategies for effectively integrating AI into the classroom.

### *Sitting in Our Emotions*

Model	Targeted Dimensions
Modified Kübler-Ross Change Curve Model	Shock, Denial, Frustration, Depression
Technology Acceptance Model (TAM)	External Variables

Before we can begin to help our students learn about AI tools, we need to process our own emotions about the changes facing education. This means taking the time to move through the stages of the modified *Kübler-Ross Change Curve Model* and acknowledging the loss of what we had been doing while also figuring out a new way forward with teaching and learning. Some instructors may be in a position to move more quickly through the early stages of the modified *Kübler-Ross Change Curve Model*, or they may be in fields where AI tools are seen as interesting rather than potentially threatening. Other instructors may be in fields where AI could be seen as an existential threat and/or they may be in adjunct or tenure-track positions meaning that they may have less power to make changes and less bandwidth to focus on adjusting assignments and teaching methods. It may feel like AI is an external variable that was forced upon them without their consent. We may find ourselves sitting in the *shock, denial, frustration, or depression* stages of the modified *Kübler-Ross Change Curve Model* as we struggle to determine how to move forward in the classroom. In those moments, we can give ourselves permission to feel the sadness of what has abruptly changed. We can, and maybe even should, grieve at that loss.

We might also identify with the *external variables* stage of the *TAM* at this point. Remember that Marikyan and Papagiannidis (2023) note that external variables influence perceived usefulness and perceived ease of use. We may feel external pressure to integrate AI tools even if we aren't yet able to see their value or use in our teaching. We may need to process these emotions as well before we can begin to see where we might add AI tools to our courses in ways that seem appropriate for our students. It is only once we have 1) acknowledged the changes that AI has brought and 2) addressed our feelings about these changes that we can begin to refocus our energies on how to keep our subjects relevant in the age of AI.

## My Observations

If you are one of the early AI adopters in your institution or if you processed through these modified *Kübler-Ross Change Curve Model* and the *TAM* stages quickly, it can still be beneficial to acknowledge that

not all instructors are in the same place. Your colleagues and students may still need space to figure out what the future looks like for them. Perhaps you can find ways to lead faculty discussions or trainings as a way to help others learn how AI might impact their teaching. For your students, provide guidance and grace as they navigate completing assignments and projects in the context of AI availability. Once you have allowed yourself time to grieve if needed, you can begin to consider the shifts and challenges that may lie ahead.

### *Foundational Understanding*

Model	Targeted Dimensions
<i>Modified Kübler-Ross Change Curve Model</i>	Experimentation
<i>Technology Acceptance Model (TAM)</i>	Perceived Usefulness, Perceived Ease of Use

The initial step in integrating AI tools into education involves helping students comprehend their academic and future professional responsibilities. In an academic context, students are required to engage in reading, writing, research, synthesis, critical thinking, and knowledge demonstration. In professional settings, similar tasks may be encountered, albeit with less emphasis on regular knowledge demonstration. While AI may alter methodologies, it likely will not impact the underlying rationale for these tasks. The TAM stages of *perceived usefulness* and *perceived ease of use* (Rahimi et al., 2018) significantly influence attitudes toward novel technologies (Marikyan & Papagiannidis, 2023). These stages prove beneficial as educators transition to the *experimentation* stage of the modified *Kübler-Ross Change Curve Model*.

During the *experimentation* stage, educators can teach prompting skills and highlight various AI tools, subsequently allowing students to experiment and reflect on their experiences. This transition into a playful learning environment gives students the opportunity to explore these tools without academic penalties and to reflect on their usefulness.

Regarding professional tasks, students can participate in workshops and lectures to gain insight into potential job responsibilities. This

exposure illustrates how tasks may have evolved or remained consistent over time, as well as how AI tools might enhance task completion.

Once students grasp their academic and professional expectations and how AI tools might impact these responsibilities, educators can purposefully introduce AI tools in the classroom. It is helpful to demonstrate multiple programs for task completion, enabling students to gain generalizable skills rather than proficiency in specific AI tools. Given that these tools may evolve or become obsolete by the time students graduate, developing the ability to interact with AI tools broadly becomes a crucial skill. Unlike previous approaches where students might have taken courses on specific software programs, the classroom of the future should prioritize skills that are transferable across various AI tools.

## My Observations

For me, this was the first place that made sense to start. After I worked through some of the earlier stages of the modified *Kübler-Ross Change Curve Model*, I began to try to understand what different AI tools could do. I needed to have at least a basic understanding of the tools often used in my field before I started talking with my students about them. But I was in a time crunch since I only had about two weeks before the new semester started. This time crunch pushed me to progress through the stages of the modified *Kübler-Ross Change Curve Model* and the *TAM* more quickly than other instructors might be comfortable with.

## Hands-on Experience

Model	Targeted Dimensions
<i>Modified Kübler-Ross Change Curve Model</i>	Experimentation, Implementation
<i>Technology Acceptance Model (TAM)</i>	Attitude Toward Using

Providing low-stakes opportunities for students to engage with various AI programs creates a safe learning space and allows for mistakes to be corrected before causing problems at later stages. The *TAM* stage

of attitude toward using influences real-world AI tool adoption for both instructors and students (Marikyan & Papagiannidis, 2023). As instructors progress to the experimentation and implementation stages of the modified Kübler-Ross Change Curve Model, students may feel more comfortable exploring AI tools because they hear their instructors discussing options for AI integration. Examples of student engagement with AI tools include:

- Computer science workshops on AI-assisted coding
- Writing course sessions for AI-augmented brainstorming, outlining, drafting, and feedback
- Business school AI simulations and case studies
- Nursing education on AI-generated patient care plans
- Teacher training on AI-assisted lesson planning

Regardless of the discipline, students must understand where their own expertise and workplace knowledge remain crucial. They should develop the ability to critically evaluate AI outputs and seek accurate information when necessary. Instructors need to emphasize that AI should augment, not replace, topical knowledge.

### Potential Template for AI-Integration

While disciplines vary, certain fundamental strategies may apply universally for how to introduce and integrate AI tools into teaching and learning spaces.

1. **Evaluate course learning objectives.** Identify critical knowledge and skills students must gain and prioritize these elements.
2. **Reassess existing assignments in light of AI capabilities.** Consider modifications to deter AI overreliance or explore alternative methods to achieve learning outcomes. For instance, replace discussion posts with concept maps or visual representations.
3. **Foster student relationships.** Small gestures can build trust, increasing student compliance with AI guidelines.
4. **Demonstrate personal AI usage and encourage students to reciprocate.** Illustrate the tools' neutrality, emphasizing the importance of responsible application.

**5. Collaboratively develop AI usage guidelines with students.**  
Engaging students in the process enhances adherence to the final class rules.

### My Observations

Students have shown that they value in-class experimentation with AI tools. This experience allows students to learn from each other and ask questions if they are confused. This shared experimentation time also allows the students who might be hesitant about AI tools to benefit from the excitement or energy of classmates who are more comfortable testing AI tools.

### *Interdisciplinary Learning and Real-World Applications*

Model	Targeted Dimensions
<i>Modified Kübler-Ross Change Curve Model</i>	Experimentation, Implementation
<i>Technology Acceptance Model (TAM)</i>	Attitude Toward Using, Behavioral Intention to Use

Integrating interdisciplinary thinking requires instructors to embrace AI tools and determine appropriate tasks for human-only or AI-augmented work. Student attitudes toward AI must also be considered. Despite surveys like the one from BestColleges noting that “56% of college students have used AI on assignments or exams” (Nam, 2023), not all students are using AI or are comfortable with AI. As we seek to help our students, instructors should consider their own *TAM attitude toward using* AI tools. This reflection helps instructors decide which tasks might benefit from AI assistance and which are best left to humans alone. Instructors may also need to have the modified *Kübler-Ross Change Curve Model* attitudes of *experimentation* to learn about useful AI tools and *implementation* to incorporate new ideas into their teaching.

Once students are more comfortable with AI tools such as LLMs, instructors can introduce research programs like Perplexity.ai or Connected Papers for finding valid sources. This advances instructors

to the *TAM* stage of *behavioral intention to use*. AI can also be employed to create discussion questions or classroom activities. Students can utilize AI to explore different perspectives or communicate with unfamiliar audiences. Role-playing exercises with AI can help students understand diverse viewpoints. And inviting workplace professionals to discuss AI use in their fields provides students with valuable industry insights. There are myriad ways to help students gain comfort in integrating AI tools into their workflow.

## My Observations

Some of the most insightful learning experiences with AI tools have been when I've spoken with faculty in fields different from my own. I have learned a great deal from hearing how instructors in chemistry, business, math, nursing, and kinesiology are using AI tools in their courses. This is another way that enthusiastic energy about experimenting with the AI tools can encourage other instructors to consider integrating AI tools into their own teaching.

## Critical Thinking

Model	Targeted Dimensions
Modified Kübler-Ross Change Curve Model	Integration
Technology Acceptance Model (TAM)	Actual System Use

Critical thinking skills remain essential across all disciplines. However, research indicates that teaching these skills in isolation from course content is ineffective (Hendrick, 2017). To help students integrate critical thinking skills into their use of AI tools, it is beneficial for instructors to have progressed to the *integration* stage of the modified *Kübler-Ross Change Curve Model* and the *actual system use* stage of the *TAM*. Instructors can support critical thinking development through:

- 1. Problem-based learning modules related to AI:** These exercises encourage students to solve real-world problems using AI tools. This can range from simple tasks, such as asking AI for opposing

viewpoints, to more complex exercises involving specific prompt writing. This approach helps students view AI as a tool for task completion rather than a replacement for their own work.

2. **Critical analysis assignments:** Essays that require students to analyze AI-related policies, innovations, and controversies can sharpen analytical skills and broaden understanding of AI's role in the workplace. Adding a presentation component to these assignments allows for deeper discussion of AI-related issues.
3. **AI output critique and reflection:** Students should be encouraged to critically evaluate AI-generated content and reflect on its usefulness. This cycle of use, reflection, and critique helps students maintain a balanced view of AI as a fallible tool rather than an infallible authority.
4. **Regular, short interactions with AI:** Brief, frequent engagements with AI tools, followed by critical evaluation of the results, can be highly effective. For example, using AI research tools to answer current questions, then critiquing the sources used, can lead to valuable discussions on source validity and reliability.
5. **Reflection pieces:** Incorporating reflection components into projects where AI tools are used can enhance critical thinking. Students can be asked to consider the AI's usefulness at various stages of their work and evaluate how much of the AI-generated content they ultimately incorporated into their final product.

By implementing any or all of these strategies, instructors can help students develop the critical thinking skills necessary to effectively utilize AI tools in both academic and professional settings. This approach ensures that students learn to view AI as a complement to their own skills and knowledge, rather than a substitute for human reasoning and creativity.

## My Observations

Shorter and regular interactions with AI can be helpful for encouraging critical thinking skills. For example, we can use Perplexity to search for an answer to a current question and then have the students critique the value of the sources used. One of my favorite recent moments was where two of the six sources in a Perplexity response were from

Reddit. We spent a few minutes discussing the validity and usefulness of a Reddit thread to build a reference page. I was pleased to hear my students talk through their concerns so well.

Adding reflection pieces to the end of every project is another effective way to again encourage critical thinking skills. I ask students to employ AI in places throughout a project if they are comfortable doing so and then reflect on the usefulness of the output and how much of the output they used to create the final project. By asking students to think across the lifespan of a project, they can get a clearer understanding of where AI was or wasn't helping in their outlining, drafting, writing, and critiquing/editing stages. These reflections end up helping students more than if I just lectured to them about appropriate AI use.

### Communication Skills

Model	Targeted Dimensions
<i>Modified Kübler-Ross Change Curve Model</i>	Integration
<i>Technology Acceptance Model (TAM)</i>	Actual System Use

Despite initial concerns, widespread issues with students' communication skills due to AI tools largely seem not to have materialized (MacGregor, 2024). To that end, instructors should continue in the *integration* stage of the modified *Kübler-Ross Change Curve Model* and the *actual system use* stage of the *TAM*. To enhance students' communication abilities, instructors can assign targeted writing tasks for specific audiences, followed by class presentations. This approach demonstrates that while AI can augment writing, effective communication of original ideas remains crucial. Incorporating presentations with Q&A sessions simulates workplace scenarios and reinforces students' responsibility for AI-assisted content.

Encouraging students to enroll in technical writing and communication courses is beneficial. These specialized courses teach nuanced aspects of effective communication and audience understanding. Bowen and Watson (2024, p. 47) emphasize the vital role of liberal arts courses in preparing students for "AI-inspired" jobs post-graduation. These courses also provide opportunities to explore appropriate integration of AI skills with students' own communication abilities.

Instructors should help students find their unique voice and express their ideas clearly as they learn to work with AI. This includes assisting them in working with AI to improve application letters and workplace documents while maintaining authenticity. Preparing students to articulate their AI skills to potential employers may be a differentiating factor in whether or not the student received a job offer. By implementing these strategies, instructors can help students develop robust communication skills while maintaining their unique perspectives.

### AI-Assisted Writing Workshops

Students may benefit from extracurricular workshops for AI tool experimentation. Writing faculty, graduate students, or campus AI experts could facilitate these workshops where participants explore various AI tools and prompting techniques to enhance task completion. The primary objective for these experimentation workshops is to provide a non-judgmental environment for students to familiarize themselves with AI tools and their functionalities.

### Collaborative AI Projects

Group projects present inherent challenges and with widespread AI accessibility, it is important to address potential AI contributions and mitigate risks of misuse. Instruct groups to establish AI usage guidelines, including acknowledgment of how to address any violations of these guidelines.

Encourage students to experiment with using an LLM to create their group project plan. Students often struggle to envision what a complete project entails and an LLM can provide guidance on task identification, member assignment, and project timeline generation.

### My Observations

Students who are from lower socio-economic backgrounds, who speak English as a second language, or who have certain neurodiversity diagnoses such as being on the autism spectrum may all find increased

value in employing AI tools help them increase their communication skills. This does not mean that AI can do a better job of communicating than the students can; AI should supplement, not replace, their own abilities.

### *Ethical Implications*

Model	Targeted Dimensions
<i>Modified Kübler-Ross Change Curve Model</i>	Integration
<i>Technology Acceptance Model (TAM)</i>	Actual System Use

Different fields grapple with unique ethical implications of AI and LLM use. The classroom provides an ideal space to begin these discussions. Instructors should encourage students to read about ethical concerns within their disciplines, leading to classroom discussions on appropriate AI use by task and purpose. These discussions allow students to learn about their peers' comfort levels with different AI tools and gain an understanding of their own comfort levels as well. As a starting place, Lance Eaton's (2023) "Syllabi Policies for Generative AI" may provide helpful ideas for course and assignment structuring.

Instructors can function as agents of change on their campuses by sharing experiences of *integration* of the modified *Kübler-Ross Change Curve Model* and *actual system use* of the TAM. To that end, instructors can collaborate to organize debates, roundtables, expert lectures, and workshops on ethical AI use across fields. This approach exposes students to diverse ideas and helps students understand that AI ethics is not a monolithic topic.

In my own courses, students are asked to color all AI-generated text red. It helps me see where students might be struggling with their writing or idea generation and invites conversations about the AI-generated information. This also helps me to demonstrate the *integration* stage of the modified *Kübler-Ross Change Curve Model* and *actual system use* of the TAM.

1. Are they confused about the information that the AI tool gave them?
2. Did they feel like the AI said it better?

3. Was the student approaching the deadline and didn't have time to rewrite the AI-generated content?
4. Something else?

By listening to and understanding why students have used AI to generate parts of their text, I can shift the conversations to a learning space rather than spending time trying to police students' AI use. I can also demonstrate that transparent use of AI tools can be ethical, which helps to remove some of the stress from students in completing their assignments.

### My Observations

I ask students to write reflections about their AI use after every paper or project and discuss how helpful different AI tools were. The reflection piece is exceptionally important in helping students understand what ethical, responsible, and transparent AI use looks like, and it helps them to see where AI was not as helpful as they might have hoped that it would be. These reflections also emphasize that AI tools can be quite useful in some instances.

### Adaptability and Lifelong Learning

Model	Targeted Dimensions
<i>Modified Kübler-Ross Change Curve Model</i>	Integration
<i>Technology Acceptance Model (TAM)</i>	Actual System Use

While teaching specific AI tools has value, creating a community desire for lifelong learning is essential. This approach helps students understand that while AI programs may change, the need to adapt to new technologies remains constant. Instructors should focus on concepts applicable to multiple tools rather than specific programs to avoid the risk of students prioritizing tools over critical thinking skills or understanding general AI use strategies.

Instructors can demonstrate that learning about AI is an ongoing process by regularly discussing their own engagement with AI tools. AI hackathons or competitions, particularly at the departmental

or college level, can teach students invaluable skills like quick tool adoption, adaptability, and teamwork for large or unexpected tasks. At this point, instructors need to be in the *integration* stage of the modified *Kübler-Ross Change Curve Model* and the *actual system use* stage of the TAM. Instructors must take time to encourage learning for the sake of the knowledge rather than for a grade so that students will understand that learning does not stop at the edge of the college property.

### My Observations

Regular discussions of what I have learned and how I am using AI tools can increase understanding that learning about AI tools is not a one-time endeavor. We have to understand that a tool that we loved yesterday might change tomorrow or that one tool might be good at a certain task and another tool might be better at a different task. The tools we use may change based on updates, meaning that we have to practice the skill of lifelong learning as well.

### *Practical Strategies for AI Integration into the Classroom*

Model	Targeted Dimensions
<i>Modified Kübler-Ross Change Curve Model</i>	Integration
<i>Technology Acceptance Model (TAM)</i>	Actual System Use

Integrating AI tools, especially LLMs, into our classrooms is changing how we teach. In order to deeply engage with practical ideas for AI tool integration, instructors should be in the *Modified Kübler-Ross Change Curve Model* stage of *integration* and the TAM stage of *actual system use*. This section explores practical strategies for implementing AI tools in various disciplines, with a focus on ethical, responsible, and transparent usage to enhance student learning outcomes.

### Case Studies from Different Disciplines

Case studies can be effective when introducing students to new ideas and voices aside from that of the instructor. Students may benefit from

the inclusion of outside voices to make a point more efficiently than through lecture alone.

- 1. STEM:** In a computer science course at Stanford University, instructors integrated GPT-3 into programming assignments, allowing students to employ AI as a coding assistant (Finnie-Ansley et al., 2022). This approach helped students gain a deeper understanding of code structure and problem-solving strategies, while also teaching them to critically evaluate AI-generated code.
- 2. Humanities:** A director of research built a study to assess critical thinking skills by “using LLMs to detect elements of critical thinking from discussion forum data” (Lee, 2024). Students may need help to understand where critical thinking skills are necessary or are being used. Assessing those skills and providing students with feedback can help students internalize those skills.

### Step-by-Step Guide for Implementing AI Tools in Classroom Activities

One hurdle for instructors in implementing AI tools in classroom activities can be knowing where to start. These steps can enable instructors to feel more comfortable with implementing AI tools.

1. Assess learning objectives and identify areas where AI can add value.
2. Select appropriate AI tools aligned with course goals and student needs.
3. Develop clear guidelines for AI usage, emphasizing ethical considerations.
4. Introduce AI tools gradually, providing discussion and experimentation space for students.
5. Design assignments that leverage AI capabilities while promoting critical thinking.
6. Implement safeguards to prevent over-reliance on AI and maintain academic integrity.
7. Regularly evaluate the impact of AI integration on learning outcomes and adjust accordingly.

## Examples of Successful AI-Augmented Assignments

Instructors may find successful AI-augmented assignments from others to be a good starting place for modification in their own teaching.

1. **Collaborative Writing:** Students employ LLMs as brainstorming partners to generate ideas for essays, then critically evaluate and refine the AI-generated content (Shaer et al., 2024).
2. **Language Learning:** AI-powered chatbots serve as conversation partners for language students, and student responses to the bots are recorded (Belda-Medina & Calvo-Ferrer, 2022).
3. **Assignment guidelines:** AI-use instructions are given on assignment sheets so that students know what acceptable AI use looks like (Dumin, 2023a).

## Strategies for Overcoming Common Challenges in AI Integration

Reading about strategies that others have implemented when working with AI tools can help instructors determine the best way to present these topics to students.

1. **Addressing Equity Concerns:** Help to ensure safety of users and reduced bias in AI outputs (Abrams, 2024).
2. **Maintaining Academic Integrity:** Transform assessment strategies to maintain academic integrity in the age of AI (Xia et al., 2024).
3. **Balancing AI Assistance and Independent Learning:** Design assignments that require students to critically evaluate AI-generated content, promoting information literacy and analytical skills (Bowen & Watson, 2024).
4. **Ethical Considerations:** Integrate discussions on AI ethics into the curriculum, encouraging students to reflect on the implications of AI use in their field of study (Dumin, 2023b).

## My Observations

While concerns regarding the origins and training of different AI tools persist, prioritizing actionable steps is crucial. Since early 2023, my

experience in AI education has emphasized the importance of instructing students in ethical, responsible, and transparent AI usage and of mirroring that back to them when I use AI. When questioned about preventing students from using AI inappropriately, I emphasize these principles and the significance of encouraging interpersonal relationships. Students who experience honesty are often inclined to reciprocate.

By implementing some or all of these strategies, educators can harness the potential of AI to enhance learning experiences while promoting critical thinking, ethical awareness, and digital literacy skills essential for the 21st-century workforce.

## Long-Term Implications of AI Integration

The rapid evolution of AI tools means that educators must be continuously adapting. This ever-changing technology might send instructors back to earlier stages of the modified *Kübler-Ross Change Curve Model* and the *TAM*—stages they thought they'd already conquered. Such regression is a normal response to technological shifts and should be approached with patience and a focus on familiar, comfortable aspects of AI integration.

Instructors serve as crucial guides for students navigating the complexity of AI tools. Our job is to help students navigate through this new, sometimes confusing territory. Students have a diverse range of AI familiarity and usage patterns. Some students may have primarily encountered AI in the context of prohibitions or unethical applications, while others may demonstrate advanced proficiency that surpasses that of their instructors. In instances where highly skilled AI users are present in a course, it may be beneficial to lean on their expertise by inviting them to lead class discussions on appropriate tool usage and best practices.

The majority of students express a desire for adequate preparation for their post-graduation AI-augmented work lives (Langreo, 2023). They want to hit the ground running in an AI-powered world. As educators, it is our responsibility to equip them with the necessary tools and strategies to thrive in the workplace. This includes not only familiarizing students with relevant AI technologies but also teaching them how to effectively communicate their AI-related skills to potential employers, thereby demonstrating their value to prospective organizations.

## Ethical Considerations

There is often a technology gap between teachers and students, as if we are speaking different dialects of the same digital language. Students may have been immersed in technological environments from an early age, leading to a normalization of digital tools that instructors are still in the process of fully comprehending and integrating into their practices. This potential misalignment of technological worldviews underscores the critical importance of clear, explicit instruction on ethical AI use within academic contexts and specific fields of study.

Educators must not only list guidelines for appropriate AI use but also explain the rationale behind these parameters. It is incumbent upon instructors to explain the underlying principles and potential consequences that inform AI usage policies. Students often adhere more closely to AI-use guidelines when they understand how academic and professional communities might perceive their AI use and its broader implications.

When we help students understand the nuances of using AI ethically, we're building a bridge that connects different generations' views on technology and creates a shared playbook for using AI responsibly in school and at work. This approach not only ensures students comply with ethical standards but also prepares them to navigate the complex ethical world in their future careers.

## Conclusions

Publicly accessible AI tools have undoubtedly complicated instructors' professional lives, potentially generating more questions than answers. Educators may find themselves at various stages of the modified *Kübler-Ross Change Curve Model* and the TAM, stages that might shift based on what they are teaching and how they are teaching it. To support instructors navigating these challenges, we must provide space for processing emotions and facilitate discussions about preserving essential course elements. Organizing guided workshops and experimentation sessions can also prove beneficial for faculty exploring diverse AI tools while navigating their emotions around these tools.

Educators might find inspiration in the Rose family's adaptation and growth, drawing a parallel to the character development in *Schitt's Creek*. Rather than continuing to resist change, the protagonists discovered opportunities to thrive within their new environment. This narrative offers a valuable perspective when considering the impact of AI tools on academic courses, departments, and the future professional lives of our students.

Right now, we are standing at a crossroads in education. This can be our chance to shake things up and reshape how we teach. This shift necessitates that instructors do two things: 1) figure out how AI fits into our own teaching, and 2) lend a hand to our colleagues who might still be finding their footing. Educators must collaborate to achieve this shifting adaptation. By emulating the Rose family's approach, educators can strive to find balance with the evolving AI technology, creating alliances and working collectively to equip students for the challenges and opportunities of an AI-integrated future. As colleagues share their successes, it may be apt to respond with Alexis Rose's encouraging words: "I love that for you!"

## Discussion Questions

1. Thinking about the modified *Kübler-Ross Change Curve Model* and the *TAM*, where do you find yourself in those models? Have you seen a shift in your attitudes and employment of AI tools since spring 2023? What are some steps that you might take to continue your movement through those models if you haven't gotten to the end yet?
2. Thinking about Leon Furze's *AI Assessment Scale*, where do your thoughts on students in your courses using AI tools fall?
3. How are you seeing AI tools impact your courses, your assignments, and your department or field?
4. What are some changes that you might make to your assignments to help both AI-proof them and help shift the learning objects to meet the needs of students in the age of AI tools?
5. What are ways that you can co-learn about AI tools with your students or other faculty in your department or college? Are there already learning spaces and opportunities on campus? Or is that something that you might be interested in creating?

## References

Abrams, Z. (2024). Addressing equity and ethics in artificial intelligence. *American Psychological Association*, 55(3). [www.apa.org/monitor/2024/04/addressing-equity-ethics-artificial-intelligence](http://www.apa.org/monitor/2024/04/addressing-equity-ethics-artificial-intelligence)

Belda-Medina, J., & Calvo-Ferrer, J. R. (2022). Using chatbots as AI conversational partners in language learning. *Applied Science*, 12(8427). <https://doi.org/10.3390/app12178427>

Bowen, J. A., & Watson, C. E. (2024). *Teaching with AI: A practical guide to a new era of human learning*. John's Hopkins UP.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. <https://doi.org/10.2307/249008>

Dumin, L. (2023a). *Creative commons files*. <https://wordpress.com/post/ldumin157.com/91>

Dumin, L. (2023b, May 29). How I approached AI-literacy in the writing classroom. *Medium*. <https://medium.com/@ldumin157/how-i-approached-ai-literacy-in-the-writing-classroom-d04e7031c87f>

Eaton, L. (2023, September 15). *Syllabi policies for generative AI*. [spreadsheet]. [https://docs.google.com/spreadsheets/d/1lM6g4yveQMyWeUbEwBM6FZVxEWCLfvWDh1aWUErWWbQ/edit?fbclid=IwY2xjawEP2-1leHRuA2FlbQIxMAABHbQ5BrILhhWOMMYdlu23di02Ppjk3Aq-tXGg\\_6dCrr0EBScbNimRmDHcfQ\\_aem\\_tz7g-JBFnAnDAf30w268Cw&gid=118697409#gid=118697409](https://docs.google.com/spreadsheets/d/1lM6g4yveQMyWeUbEwBM6FZVxEWCLfvWDh1aWUErWWbQ/edit?fbclid=IwY2xjawEP2-1leHRuA2FlbQIxMAABHbQ5BrILhhWOMMYdlu23di02Ppjk3Aq-tXGg_6dCrr0EBScbNimRmDHcfQ_aem_tz7g-JBFnAnDAf30w268Cw&gid=118697409#gid=118697409)

Enablers of Change. (2023). *What is the Technology Acceptance Model?* [www.enablersofchange.com.au/what-is-the-technology-acceptance-model/](http://www.enablersofchange.com.au/what-is-the-technology-acceptance-model/)

Finnie-Ansley, J., Denny, P., Becker, B. A., Luxton-Reilly, A., & Prather, J. (2022). *The robots are coming: Exploring the implications of OpenAI Codex on introductory programming*. ACM Digital Library. <https://doi.org/10.1145/3511861.3511863>

Furze, L. (2023a, April 29). *The AI assessment scale: From no AI to full AI*. <https://leonfurze.com/2023/04/29/the-ai-assessment-scale-from-no-ai-to-full-ai/comment-page-1/>

Furze, L. (2023b, December 18). *The AI assessment scale: Version 2*. <https://leonfurze.com/2023/12/18/the-ai-assessment-scale-version-2/comment-page-1/>

Hendrick, C. (2017, January 26). Why students should not be taught general critical-thinking skills. *The London School of Economics and Political Science*. <https://blogs.lse.ac.uk/impactofsocialsciences/2017/01/26/why-students-should-not-be-taught-general-critical-thinking-skills/>

Langreao, L. (2023, November 10). Students want to learn more about AI: Schools aren't keeping up. *Education Weekly*. [www.edweek.org/technology/students-want-to-learn-more-about-ai-schools-arent-keeping-up/2023/11](http://www.edweek.org/technology/students-want-to-learn-more-about-ai-schools-arent-keeping-up/2023/11)

Lee, J. (2024, May 14). Leveraging LLMs to assess soft skills in lifelong learning. *Times Higher Education*. [www.timeshighereducation.com/campus/leveraging-llms-assess-soft-skills-lifelong-learning](http://www.timeshighereducation.com/campus/leveraging-llms-assess-soft-skills-lifelong-learning)

MacGregor, K. (2024, February 2). Most students use AI for studies, digital divide emerges—Survey. *University World News*. [www.universityworldnews.com/post.php?story=20240202105653757](http://www.universityworldnews.com/post.php?story=20240202105653757)

Marikyan, D., & Papagiannidis, S. (2023). Technology Acceptance Model: A review. In S. Papagiannidis (Ed.), *TheoryHub Book*. <https://open.ncl.ac.uk>

Nam, J. (2023, November 22). 56% of college students have used AI on assignments or exams. *BestColleges*. [www.bestcolleges.com/research/most-college-students-have-used-ai-survey/](http://www.bestcolleges.com/research/most-college-students-have-used-ai-survey/)

Rahimi, B., Nadri, H., Afshar, H. L., & Timpka, T. (2018). A systemic review of the Technology Acceptance Model in health informatics. *Applied Clinical Informatics*, 9(3), 604–634. doi:10.1055/s-0038-1668091.

Shaer, O., Cooper, A., Mokryna, O., Kun, A. L., & Shoshan, H. B. (2024, February 29). *AI-augmented brainwriting: Investigating the use of LLMs in group ideation*. <https://arxiv.org/html/2402.14978v2>

WebMD. (n.d.). *Grieving and stages of grief*. [www.webmd.com/balance/grieving-and-stages-of-grief](http://www.webmd.com/balance/grieving-and-stages-of-grief)

Xia, Q., Weng, X., Ouyang, F., Lin, T. J., & Chiu, T. K. F. (2024). A scoping review on how generative artificial intelligence transforms assessment in higher education. *International Journal of Educational Technology in Higher Education*, 21(40). <https://doi.org/10.1186/s41239-024-00468-z>



**Taylor & Francis**  
Taylor & Francis Group  
<http://taylorandfrancis.com>

# Part V

## Future Trends and Implications of AI in Education



**Taylor & Francis**  
Taylor & Francis Group  
<http://taylorandfrancis.com>

# Redefining Assessments in the Age of AI **13**

*Debby R. E. Cotton, Lynne Wyness,  
Ben Jane, Pete A. Cotton*

## Introduction

Generative AI (GenAI), especially large language models (LLMs) such as ChatGPT, Bard, and Claude, pose a challenge to many traditional assessment processes, and thus to student learning which is often led by assessment requirements. LLMs can very rapidly generate plausible-sounding text in multiple languages and styles, and detecting whether students have used GenAI to produce a piece of work for assessment is difficult and unreliable (Bentley et al., 2023; Cotton et al., 2024). Of particular concern is the coursework essay which has dominated assessment in many disciplines for some years, but which can often be relatively successfully replicated with very little skill or effort on the part of the student by LLMs (Herbold et al., 2023). However, many other widely used forms of assessment, including multiple choice and short answer questions, as well as reflective writing and coding tasks, can also be completed using GenAI, though its success varies across disciplines (Lo, 2023; OpenAI, 2023). According to recent research, students are already using ChatGPT in large numbers (Freeman, 2024; Newman & Gulliver, 2023), thus it is potentially very disruptive to traditional modes of assessment.

Despite these issues, there are some positives to the emergence of GenAI in education. Some educators would argue that a review of assessment processes is long overdue; that many of our current assessments are both inauthentic (not reflecting activities which are undertaken outside of

educational contexts), and antiquated (assessing skills that are increasingly obsolete) (Swiecki et al., 2022). The rapid spread, scope, and abilities of LLMs such as ChatGPT have increasingly led educators to question the purposes of assessment as well as the means to achieve it. If assessment is simply about grading, are there new ways of doing this? If it is to help students develop knowledge and understanding, we may need to develop more dynamic assessment and feedback processes. There are some significant questions being asked about the logic of asking students to memorize large amounts of information when relevant facts are so easily obtained and assembled by GenAI. Critical thinking will become increasingly important—as will the need to distinguish between accurate and inaccurate information in a “post-truth” world.

In this chapter, we will explore how the integration of GenAI technology is transforming the traditional assessment process and redefining the concept of assessment itself. We discuss the assessment challenge in education, consider academic integrity issues, and outline the benefits and challenges of using GenAI in assessments. We also provide practical insights into how educators can best utilize this technology to enhance the assessment process, preparing students for work and life outside the classroom.

## The Assessment Challenge in Education

There is a wealth of literature on assessment in a multitude of educational contexts, marked by debates over the *what* and *how* of assessment, the reliability of assessment as a measure of learning, and raising educational outcomes through assessment—each one replete with a vocabulary of contestation and challenge. Over the past 60 years, educators worldwide have grappled with key issues in assessment and have responded with ever-evolving strategies.

One fundamental challenge is the appropriateness of assessment to purpose. Summative assessment aims to provide assurance that the learning outcomes of the course have been met, whereas formative assessment is primarily intended to support students in enhancing their learning. In terms of summative assessment, standardized methods have dominated the educational landscape since Victorian times, where high stakes culminating tests and examinations have striven for reliability and consistency by testing learners’ ability to reproduce

knowledge acquired via their curriculum. Although the standardized approach to assessment continues to have many advocates, it has also provoked some of the fiercest criticisms of educational practices (see for example Kohn, 2000; Ryan & Weinstein, 2009). Ask anyone who attended school in the last 80 years to recount their memories of being assessed and you are likely to hear emotive stories of examination halls, pre-exam nerves, and receiving devastating results that had an unquantifiable impact on their subsequent life experiences.

In part as a response to the perceived inequality (and severity) of this standardized assessment system, educators have explored learning opportunities that are less teacher-centric and more personalized (Stiggins, 1991). Teachers grew frustrated with a standardized assessment system that was unable to provide an accurate representation of what their students had learnt. It certainly could not give an accurate picture of whether their learning had been integrated at a deeper level or whether, if called upon, they would be able to apply their knowledge in context. From an operational perspective, the traditional focus on high-stakes assessment has narrowed the focus of educators toward teaching a curriculum tailored for exam success. The lament of “teaching to the test” is never far from educators’ lips and many argue that education has been weakened due to unimaginative and unreliable assessment regimes (Hikida & Taylor, 2023; Jones et al., 2003; Spann & Kaufman, 2015).

Calls for the diversification of assessment, particularly in compulsory schooling, grew louder in the 1990s and alternative assessment strategies, such as coursework and portfolios, were utilized. Alongside this shift, educational research has provided insight into cultural and racial biases within traditional forms of assessment that have historically placed more disadvantaged groups in positions of further inequity (Kozlowski, 2015; Madaus & Clarke, 2001). With the recent acknowledgement of the impact on learning of neurodiversity and learning disabilities, a diverse, inclusive assessment diet has become more common practice in educational institutions.

The “what” of assessment has also been a subject of considerable debate over the decades. Assessment practices continue to shift away from testing ability to retain and reproduce knowledge content, and toward enabling learners to demonstrate skills, competencies, and even values. The landscape of education has changed in alignment with societal needs, prompting a re-evaluation of *what* is taught in

schools and universities, and *how* it is taught, emphasizing “real-world” skills such as teamwork, problem-solving, creativity, leadership, and critical thinking. The skills required in the world beyond the classroom cannot be reliably or authentically assessed using traditional modes of assessment, thus more active and engaged pedagogies to teach and assess such skills are being sought (Care & Kim, 2018).

The purposes of assessment have changed over time, and vocabulary has adapted accordingly. Where once assessment was considered to provide verification *of* learning (knowledge acquisition and understanding, for example), assessment is now recognized for its productive potential. Black and Wiliam (1998) lifted the lid on the “black box” of what teachers could do in their classrooms to promote better assessment outcomes, pioneering the concept of assessment *for* learning that includes formative assessment, detailed feedback, and self-assessment to enhance student preparedness. Following Black and Wiliam’s work in schools, the notion of ensuring that learners are ready for, or “literate” in, the process of assessment has gained traction in further and higher education (HE) (Nicol & Macfarlane-Dick, 2006). Assessment briefs, marking rubrics, and detailed feedback now feature in most university policies and practice. More recently, in HE, the concept of assessment-*as*-learning has gathered momentum, highlighting assessment’s integral role in deep learning through reflection and metacognition (Yan & Boud, 2021).

One further core challenge facing assessment has been the integration of technology into education and assessment, which has frequently provoked a blend of enthusiasm and alarm (Jandric & Knox, 2022). For example, the debate over whether to allow calculators into examinations and tests raged for many years before it was officially agreed that learners, who were already using calculators at home and in the classroom, could use them in many final exams. If we believe that GenAI has disrupted established and uncontested assessment practices, then we have not fully grasped the controversy that has always accompanied the practice of educational assessment.

## Assessment Reliability and Authenticity

With the widespread availability of GenAI applications today, the question of reliability and authenticity of assessment has once again

found itself at the forefront of educational research and practice. The use of the term “authentic assessments” indicates that assessment tasks are genuine examples of “extended criterion performances, rather than proxies or estimators of actual learning goals” (Kirst, 1991, p. 21). The assessment tasks should mirror, as closely as possible, the desired “real-life” skills in terms of the task, context, and criteria (Care & Kim, 2018). They are based on real-world issues, they often involve group projects or portfolios of work, and they may include practical elements such as demonstration of skills. Furthermore, they offer some potential to assess process, alongside product.

Reliability, in its simplest sense, refers to the consistency of assessment outcomes, the “reproducibility of assessment data or scores, over time or occasions” (Downing, 2004, p. 1006). We are also using the term here to imply a reliability in assessing the student’s own knowledge and skills (as opposed to the skills of a GenAI tool). Whilst there has been considerable innovation in assessment practices over the past few decades, there remains a reliance on a narrow range of assessments which each carry challenges regarding authenticity and reliability. Depending on what is being assessed, and how, the impact of GenAI will differ in extent and form. Let us consider some different assessment approaches in turn.

Despite a recent shift away from examinations and testing in some subjects, many educational contexts continue to use final exams and standardized tests to measure learning. When undertaken in-person, these traditional assessments have been least impacted by GenAI, but only when strict regulations prevent the use of mobile devices within the examination room. In-person examinations have high reliability, but low authenticity—as they cultivate skills which are little used outside of educational establishments. Moreover, the increasing use of online exams and tests has exacerbated fears around the potential for cheating and academic misconduct (Holden et al., 2021). Open-book exams that allow an extended period (usually somewhere between 4 and 48 hours) to complete work are more inclusive and authentic—but they are more susceptible to inappropriate GenAI use. There is evidence that the pandemic exacerbated problems with cheating, as assessments moved from in-person to online formats, offering greater opportunities to students who were feeling stressed and under pressure (Kaisar, 2023). GenAI use in open-book exams is less evidently a form of cheating but does raise questions about what and who is being assessed.

The mainstay of coursework assessment—the essay—has long experienced issues with academic integrity. Pre-dating the widespread use of GenAI, contract cheating, and essay mills (paid-for assessment writing companies) posed a profound challenge to assessment in post-secondary education (Medway et al., 2018). However, these were used by a relatively small number of students and were obviously identifiable to students as cheating. The same cannot necessarily be said of GenAI, where permissible uses complicate the picture with respect to academic integrity. Similarity-matching software such as Turnitin® has helped to address some of the most obvious examples of cheating and plagiarism. However, research has shown Turnitin® is not infallible, missing some plagiarism and, worse still, on occasion flagging original text as plagiarized (Foltýnek et al., 2020). Moreover, this software will only recognize text directly copied from other sources, and is unable to identify work produced by essay mills, or reliably to identify work produced by GenAI (notwithstanding the recent addition of the Turnitin® AI detector plug-in). Essay titles that are recycled year on year, and generic essay questions that test memorization of knowledge, are most susceptible to being produced by learners using GenAI. Despite the popularity of the essay as a mode of assessment it is neither particularly reliable nor does it have high authenticity.

Several modes of assessment stand out for their authenticity. Assessments are now far more likely to include end-of-term or module coursework projects or reports, and culminating assessments such as capstone projects and dissertations. The drive for more authentic assessments includes attempts to measure learning as applied to real-world scenarios. It might include independent work or placement-based projects, reflective portfolios, in-person performances, case studies, and simulations. One of the most authentic, but intensive, modes of assessment is the portfolio, which involves the collection and evaluation of a compilation of a learner's work over time. In schools, this might take the form of a curated set of art pieces produced by the pupil, or a comprehensive set of field notes produced over the course of laboratory study in the sciences. This method provides a holistic view of a student's progress and achievements and perhaps is least susceptible to cheating due to its personal and accumulative nature. Self-assessment can also serve a similar purpose and entail reflective journals or pieces of extended reflective writing, self-evaluation checklists or personal audits, and goal-setting activities.

Probably the most authentic and reliable forms of assessment available in the GenAI world, however, are performance-based assessments that assess skill development through practical demonstrations. This approach might include presentations, laboratory work, professional conversations and vivas, oral language tests, music performance exams, and practical assessments, such as the objective structured clinical examinations (OSCEs) favored by health and medical programs. The rationale behind performance-based assessments is that there is often a poor correlation between knowing *about* something and knowing *how to do* something (Palm, 2019). In vocational disciplines, this has always been an important distinction, but the value of performance-based assessments is much wider, and arguably these approaches offer the strongest potential for gaining a reliable assessment of students' abilities. Performance-based assessments offer many benefits but are hugely time intensive for teachers to undertake, and do not open themselves to the mass testing through public exams which many educational systems rely on, thus they seem unlikely to play a major role in education unless the quantity of assessment is dramatically reduced. Emphasis could be placed on more synoptic assessments that require synthesis of knowledge from diverse topic areas (Quality Assurance Agency for Higher Education, 2023), and assessments of "higher-order and critical thinking" (Kim et al., 2022).

The trade-off between authenticity and reliability, set against the issue of workload, resources, and teacher time, makes the issue of redefining assessments in the age of AI a "wicked problem" with no simple solutions. The emergence of LLMs such as ChatGPT is already having a far-reaching disruptive impact on assessment design, policy, and practice in all educational institutions and this is likely to continue, or even accelerate.

## Demonizing Generative AI

ChatGPT was launched in November 2022 and by January 2023 it was the fastest-growing consumer software application in history, with over 100 million users (Hu, 2023). While not the first LLM to become available, ChatGPT's success can be attributed to a combination of its large-scale training data, advanced natural language processing allowing it to understand nuances and context, and its continuous improvement

through user feedback. Furthermore, it proved easy to use, and the basic service was free.

Just four days after its release, amidst the flurry of media articles reporting the ability of ChatGPT to write limericks or songs in the style of Nick Cave, Professor Dan Gillmor from Arizona State University flagged the first concerns over its use in academic assessments. Gillmor asked ChatGPT to complete an assessment he gives to his students and stated, “I would have given this a good grade... Academia has some very serious issues to confront” (Hern, 2022). Soon after, Professor Darren Hick of Furman University read an essay submitted by a student which was clear and well-structured, but oddly worded and lacked references. He plugged the suspect essay into an AI writing detector, which reported that the essay had a 99.9% chance of being machine written. When confronted with this, the student admitted the offense and was reported officially (Mitchell, 2023).

Professor Hick’s warning about the ease with which students could cheat using ChatGPT, and the difficulties of detecting and proving these offences, was just the first of many. Within two weeks of its launch, schools across the USA blocked ChatGPT on their networks, citing fears over cheating and a lack of critical thinking (Johnson, 2023). In January 2023, less than two months after its release, a survey of 1,000 students found that over 89% admitted to using ChatGPT to help with a homework assignment from school (Westfall, 2023). Despite the ease of access to GenAI outside the institutions or with mobile devices, universities soon emulated schools, and the first few months of 2023 saw bans across the UK, Europe, Japan, and Australia. Universities were not merely following suit but were no doubt also responding to the growing evidence and media attention over the ability of ChatGPT to pass examinations in higher education. The free version of ChatGPT was based on GPT-3.5, which was trained on approximately 350 billion parameters (Brown et al., 2020). When first released, it could write persuasive material, but often failed to achieve the standards required at university. This changed substantially with the release of ChatGPT’s subscription service in March 2023.

Based on GPT-4, it was trained on far more information and as a result is able to pass most examinations with a performance that was on a par with human subjects: A recent review of 53 studies comprising 114 multiple choice examinations ranging from medicine and

science to economics and business showed that while GPT-3 answered around half of the questions correctly, and typically performed worse than students, GPT-4 averaged a raw test score of 80% (Newton & Xiromeriti, 2024). Furthermore, GPT-4 has passed the Turing test (originally called the imitation game by Alan Turing), the test of a machine's ability to exhibit intelligent behavior indistinguishable from that of a human (Biever, 2023). In November 2023, OpenAI confirmed that they were training GPT-5 and that it would provide significant advancements over previous models in its capabilities and accuracy, thanks to improved algorithms and an even larger training set (Murgia, 2023).

Given the rapid pace of development, the novelty of the technology, and the almost universal availability of ChatGPT, it is not surprising that there was a widespread fear of political bias, job losses, the spread of disinformation, and the existential risk that GenAI may pose to human societies or existence. While this is certainly a rapidly changing landscape, the response can also be viewed as a moral panic (Cohen, 1973) in which the perceived threat of GenAI has been exaggerated beyond its actual risk, based on limited information and speculation. In the same way that video games were once blamed for causing violence, and social media has been demonized for enabling cyberbullying (Orben, 2020), GenAI is the newest in a long line of technology "folk devils" (Phippen & Bond, 2023). As mentioned earlier, this is not dissimilar to the introduction of calculators, which were generally viewed at the time as being severely detrimental to mathematics education. A decade later a meta-analysis determined that students' operational skills and problem-solving actually improved when calculators were used in testing and instruction (Ellington, 2003), and now their use is unquestioned in most contexts. Fears of academic dishonesty, the erosion of critical thinking, and the unfair advantage GenAI may confer to some students became amplified by the media, leading to oversimplified and ineffective solutions to the perceived threat—knee jerk reactions such as banning ChatGPT and ill-considered use of technology to detect AI writing.

In response to concerns over GenAI's potential to undermine the integrity and rigor of assessments, many educational institutions across the globe have been quietly re-emphasizing or moving back toward formal examinations, following a period of assessment innovation.

Caitlin Cassidy (2023) reported in the *Guardian* that Australian universities plan to return to “pen and paper” exams after students were caught using AI to write essays; a move that while contrary to much of the educational literature (Kramm & McKenna, 2023), is nevertheless in line with the recommendations of some recent papers on the impacts of ChatGPT on assessment (e.g. Newton & Xiromeriti, 2024).

Another widely suggested strategy, and one used by Professor Hick in the first reported case of academic dishonesty using ChatGPT, is to use a tool designed to detect GenAI writing. Superficially, this appears to be a panacea, and with rapid expansion in the availability and use of GenAI tools came the implementation of standalone GenAI content detectors, as well as tools embedded into commercial platforms such as Turnitin©. However, detection of AI writing is far more complex than text matching and a recent evaluation of 14 widely used tools showed that they suffer from similar weaknesses. The authors concluded that, “the available detection tools are neither accurate nor reliable and have a main bias towards classifying the output as human-written rather than detecting AI-generated text” (Weber-Wulff et al., 2023, p. 1).

GenAI writing detection relies on reverse engineering language patterns, breaking down a piece of text and then using algorithms to quantify indices such as “perplexity” (the unpredictability of the writing) and “burstiness” (the variation in sentence structure and length). As GenAI writing is inherently predictable, these measures can theoretically be used to determine the probability that text has been created artificially. However, taking text from a GenAI tool and manipulating it to increase the perplexity of the writing can fool AI detectors. Turnitin© has one of the most accurate detection tools, but even it could be easily fooled with some manual editing or machine paraphrasing of the GenAI text (Weber-Wulff et al., 2023). Furthermore, when AI-generated content is Google-translated into other languages, the detection rate is often reduced, partly because of changes to the perplexity score, and partly because around 93% of the training used for ChatGPT was in English (Chaka, 2023). Related to this, and of particular concern in an educational context, is the finding that essays written by native Chinese speakers were misidentified as GenAI at a much higher rate than those from native English speakers (Liang et al., 2023). A final problem, for both teachers and students, is that allegedly reliable detection tools often differ widely in their scores for a particular

document yet agree on others. As they are effectively “black boxes,” it is difficult for either party to understand the algorithm’s results or to know which one to believe. Given that they do not provide evidence and are known to produce false positives (identifying writing as GenAI which is human produced), they should not be relied upon to bring a case of academic misconduct or cheating.

Of course, the techniques to detect AI writing will improve rapidly, but this is an arms race which it seems impossible for either side to win. Plagiarism detection companies will continue to develop more sophisticated tools, but LLMs are rapidly becoming both more powerful and more refined (Campbell & Jovanović, 2023). An interesting twist on the typical two-player arms race is that numerous websites, such as Undetectable AI (<https://undetectable.ai>) and StealthGPT ([www.stealthgpt.ai](http://www.stealthgpt.ai)), now offer AI powered services to avoid detection of machine writing, and numerous popular videos on YouTube offer suggestions to students on how to bypass AI detection. Furthermore, GenAI is becoming more pervasive as Microsoft Copilot is integrated into Office applications while search engines like Microsoft Bing and Google Bard have the potential to provide accurate and up-to-date information along with citations and links to the source material.

More recently, educators, technology developers, and policymakers have realized that they cannot stop the tide and must find strategies to promote responsible AI use including the development of authentic assessments and uses which harness the technology’s potential for learning. Many initial responses, such as bans in schools, have now been reversed (Lewis & Mukherjee, 2023) and universities are moving toward teaching AI literacy and incorporating the use of GenAI into assessments (Moorhouse et al., 2023). At the same time, journals are adopting a similar stance by laying out guidelines on the ethical and transparent use of GenAI in scientific publishing (Nature, 2023). GenAI is here to stay and, as the moral panic subsides, we will learn to live with another folk devil—or even to see it as a potentially useful teaching assistant.

## Leveraging Generative AI

As with the advent of any new technology, there are individuals who have enthusiastically embraced the use of GenAI in teaching, learning,

and assessment. Advocates would argue that GenAI tools will be increasingly used in the workplace and thus preparing students to use them is an important part of the educational endeavor. Research from Harvard Business School showed that consultants using AI were significantly more productive and produced higher quality outcomes than those who did not use it (Dell'Acqua et al., 2023). This has implications both for teachers (suggesting that those who embrace GenAI may be more effective—or efficient—than those who do not) and for learners (indicating that students who use GenAI appropriately to support their learning will gain better outcomes). In terms of assessment, the implications are that educators need to make GenAI use either (a) impossible for all students, or (b) acceptable practice for all. If they do not, they risk divergent assessment outcomes depending on which students have access to, and willingness to use, different GenAI tools.

When thinking about GenAI and assessment, it is important to start with the overall assessment strategy. In the light of recent developments, all educators should undertake a comprehensive review of their assessment approaches to ensure they accurately measure desired learning outcomes and key competencies, while remaining robust and meaningful in a world where students have access to GenAI tools. The reliability and authenticity of existing and future assessments should be reviewed, and student support mechanisms and academic misconduct processes updated. Guidance on how GenAI usage might be acknowledged or recorded is also worth consideration. This may involve statements about AI use being included in submitted work or it may involve students taking and keeping notes that can be reviewed should inappropriate use of GenAI be suspected at any point. Student understanding of the wider ethical implications of GenAI can be evaluated through assessments that require them to analyze critically the potential impact of GenAI on issues like privacy, job displacement, and the need for human oversight and accountability within their chosen field. One educator even asked students to “cheat” by using AI in their final paper, prompting them to grapple with responsible GenAI use within academic settings (Fyfe, 2023).

Notwithstanding concerns about the potential for GenAI misuse, there are many opportunities for using GenAI to enhance assessment. The range of uses includes supporting the work of assessment processes by developing adapted versions of existing assessments, crafting more

engaging questions, analyzing student responses, and providing timely and personalized feedback (Swiecki et al., 2022). GenAI can be used to produce adaptive quizzes, adjusting difficulty and using open-ended questions tailored to specific learning objectives or to stages of recognized frameworks such as Bloom's Taxonomy (Bloom et al., 1956) or the 5E Instructional Model (Bybee et al., 2006). By providing the topic and key concepts (or even training a GenAI tool on the entire course content), educators can use GenAI to produce a wide variety of questions, including multiple-choice items, exam questions, and essay prompts. This expanded pool of questions can reduce student familiarity with potential answers on exams, while simultaneously alleviating the workload associated with crafting numerous high-quality assessments. GenAI can tailor essay prompts to specific levels and learning objectives, ensuring appropriate challenge and focus for students.

GenAI also offers exciting possibilities beyond creating content for traditional assessments. It can be harnessed to design a wider range of assessments that are more authentic and reflect real-world application of knowledge. For example, GenAI can be used to generate realistic case studies, project briefs, and even images, using tools like DALL-E or Midjourney. If using a problem-based learning approach, GenAI can help develop realistic scenarios with branching options or examples that require students to work together to find solutions to local problems. Other approaches to embedding GenAI in assessments include the incorporation of GenAI tasks through critical engagement with specific tools. Examples include assessing students' ability to evaluate the suitability of GenAI for specific applications, critiquing outputs for accuracy and potential bias, discussing the ethical implications of GenAI use and suggesting ways of mitigating bias in outputs (Kim et al., 2022; Mollick & Mollick, 2022). Developing skills of "prompt engineering" helps students gain the best results possible from GenAI sources. Assessments can include the requirement for students to keep a record of prompts used to elicit GenAI responses, and how refining the question changed the output. Students can also utilize GenAI-powered tools (e.g., Perplexity.ai, Elicit.org, ResearchRabbit) to find relevant sources and also to facilitate the evaluation and presentation of literature through features such as mind maps and shared search outputs. These tasks can be used to assess a student's ability to

locate and differentiate credible information sources—an increasingly important task.

With GenAI, it is possible to produce multiple versions of assessment tools in a fraction of the time that would be needed without assistance. AI techniques can thus transform traditional “one-shot” assessments into a more continuous evaluation of student learning. This can involve digitizing quizzes and exams for smoother data collection, or even using entirely new assessment tasks such as intelligent tutoring systems (which can gauge students’ ability to apply knowledge in new contexts) or “stealth assessment,” in which assessment data are collected from learners while they play a digital game (Swiecki et al., 2022). AI-powered adaptive assessments can personalize the learning experience by adjusting difficulty based on student performance, ensuring an appropriate challenge for each individual (Zawacki-Richter et al., 2019). This shift toward AI-powered assessment could free up valuable educator time for higher-level tasks, however human expertise will remain central in interpreting and applying AI-generated insights.

It is also possible to use AI in support of peer assessment. Peer assessment helps students’ comprehension and criticality—but there have been concerns about the reliability of using student assessments of each other’s work. These can be mitigated by the use of AI tools which prompt student assessors to provide high-quality feedback and offer guidance for improvement as well as helping make inferences about the reliability of each assessor (Darvishi et al., 2022; Swiecki et al., 2022). GenAI can also be used to produce sample coursework that can be “peer-assessed” by a student (Mollick & Mollick, 2022). In this example, the students are asked to offer suggestions for improvement of the AI-generated essay and are marked on their prompts and the final version produced.

In other contexts, GenAI could be used as an alternative to a peer or a tutor—for example by developing virtual role-playing scenarios with chatbots (Shorey et al., 2019), or by scaffolding reflective writing by generating prompts, analyzing entries for improvement areas, suggesting relevant resources, and even aiding in grading (Cheng, 2017). AI-powered chatbots can offer students valuable feedback outside of class hours, analyze student data to provide personalized insights for educators to incorporate into their feedback, and can even be used to screen for special educational needs such as autism spectrum disorder

(Cohen et al., 2017). While teachers' time is very limited, the opportunity to receive feedback from GenAI is infinite. As in other contexts, however, risks associated with the use of chatbots in education should be carefully considered. Murtarellia et al. (2021) noted that chatbots lack many human qualities including judgment, empathy, and discretion, relying instead on algorithmic decision-making which may fail to detect important contextual issues. Nonetheless, GenAI can offer instant, personalized feedback for students on their work, generate tailored practice questions based on identified knowledge gaps, and offer adaptive learning paths that adjust to individual progress (Shibani et al., 2020). Differentiated assessments can be created with simplified text summaries or ideal answers produced which students compare to their own submission.

Whilst AI can offer potential efficiencies for grading summative assessments, its use requires careful consideration. Using AI can certainly speed up the assessment process by automating simple tasks, freeing up educator time for providing targeted feedback and engaging in complex evaluations requiring human judgment (Cotton et al., 2024). Taking this further, Gonzalez et al. (2024) describe the use of a GenAI tool which can automatically group similar answers, provide common feedback to all answers in a group, and streamline the marking process significantly. This approach also offers insights into learning trends based on student responses, enabling educators to refine assessments and improve instruction.

However, educators must critically examine the capabilities and limitations of AI-based grading with one key challenge being the limited understanding of context. Grading assessments in many subjects requires grasping subtle nuances and GenAI systems may struggle in this area (Denecke et al., 2023). Although pre-dating the GenAI explosion, research on automated essay evaluation systems noted that they are poor at assessing the quality of an argument and the intended meaning of a writer (Cheung, 2015). The reliability of algorithms, particularly in automated essay scoring, also requires further improvement to ensure accurate and trustworthy evaluations (Foltz, 2020). Further technical limitations could hinder GenAI effectiveness, for instance, assessing graphics or other non-textual elements in assessments poses a different challenge, limiting the potential use of such tools in disciplines with visual or creative components.

Although GenAI can streamline grading processes, educator involvement remains essential. Teachers play a crucial role in setting assessment criteria, interpreting GenAI-generated results, and providing valuable feedback that GenAI systems may not fully capture (Gonzalez et al., 2024). Over-reliance on GenAI could lead to a decline in meaningful personal interactions between instructors and students, a critical component of the learning process. As in other contexts, the technology should be used thoughtfully to complement, rather than replace, personalized feedback and ethical evaluation processes.

### **Plan for Future Steps: Redefining Assessments in the Age of AI**

There is increasing evidence that GenAI will impact the working lives of young people in very significant ways, and we need to help students prepare for their future professional lives. It is clear that educators need to start thinking very differently about how they assess their students if they are not already doing so. GenAI can already outperform students on many topics and in a wide range of assessment modes—and the technology is constantly developing. If banning GenAI is not practical, and detecting its use unreliable, it is up to teachers to redesign their assessments, rethinking not just how we are assessing but also what and why we are assessing. Increasingly, teachers must assume that students will use GenAI if the option is available to them; over time, it will become harder to avoid even if they wished to, as GenAI abilities become embedded into search engines and word processing software.

So, what are the key principles of assessment that we need to be taking into account in order to ensure authentic and reliable assessments in the age of AI? We summarize the key points to consider below—bearing in mind that specific solutions will depend very much on the stage of education and the subject being taught.

- 1. Be clear about the purposes of education in your specific context.** What does it mean to be an educated person in the age of AI? We need to consider what it is we want students to know and understand and why. Is it sufficient to be able to find relevant information, or are there key areas of knowledge which we want students to be

able to remember and understand fully without recourse to any digital checking? Do we want students to be skilled in assessing the accuracy and authenticity of knowledge in a discipline? If so, how can we assess this? As well as content knowledge, students will need enhanced skills of critical thinking, ethical awareness, self-reliance, and interpersonal skills (see Brown, 2023), all of which should be considered in assessment. If using GenAI, students need to be able to take responsibility for the output. Concerns about students becoming dependent upon GenAI (Chan & Lee, 2023) mean that the assessment diet should include some approaches which do not include it.

- 2. Adjust assessment types so that they either assume AI use or make it impossible.** Co-creation with AI will increasingly become the norm in everyday life and in the workplace—and many assessments will reflect this. Authentic, project-based assessments in professional contexts will increasingly assume (and in some cases explicitly encourage) the use of GenAI by all students in the same ways it might be used in a workplace setting. However, there will be areas in which we want to test what students can do without GenAI—in which case they will need to be conducted in person. This should not be simply a reversion to traditional exam mode but involve introducing assessments such as professional conversations or practical performance-based assessments. Asking students to generate new data from local environments, building in research-based assessments, or giving credit for co-curricular and extra-curricular work may also reduce the potential for GenAI to be used inappropriately (Brown, 2023).
- 3. Automate aspects of assessment and feedback to provide quick turnaround where this is possible.** Preparing exam questions, writing assessment briefs, even undertaking assessment and writing student feedback are all activities which could be automated using GenAI. GenAI could provide formative or summative feedback instantly and at scale, and there is evidence that AI marking can be at least as consistent as teacher-led marking in some contexts (Sawatzki et al., 2022). It may be that this is more acceptable for low-stakes assessments such as quick quizzes at the end of teaching sessions—but this would allow for a more continuous checking of understanding than is currently possible. By automating some elements of the teacher's role, we ensure that more precious time is freed up for interaction with students.

4. **Reduce the quantity of teacher-set and marked assessment to enable an increase in quality of assessment.** The types of complex, authentic, or in-person assessment tasks which will bring the most benefit for learning are time consuming for teachers to conduct and the marking workload could feel overwhelming with large groups. To free up time for such assessments, the quantity should be reduced. Removing assessment tasks which are susceptible to misuse of AI should be a first step, repurposing the time for other pedagogical activities. Program-based, synoptic assessments that require students to synthesize knowledge from different parts of the course offer an alternative to increasing modularization which has brought with it an ever-increasing assessment load. And undertaking GenAI-based formative assessments or low-stakes quizzes offers an opportunity for more continuous assessment of student understanding.
5. **Embed opportunities for students to develop and demonstrate skills of digital and data literacy and critical thinking.** As well as understanding the basic principles, concepts, and applications of GenAI, students will need to consider its ethical, social, and legal implications. They will need to be able to critically evaluate, analyze, and use data generated by AI, as well as to communicate and collaborate effectively with AI agents and systems. Students will need to develop critical thinking, including an ability to recognize bias and identify inaccurate information (Bentley et al., 2023). Triangulating sources and looking critically at the origins of information which they use will be key. They will also need ethical awareness to enable them to assess the benefits and harms of AI to specific groups, bringing into play wider principles of decolonization, and challenging the “algorithmic coloniality” of LLMs (Zembylas, 2023).

There remain unresolved issues however—particularly over ethics and access to AI. Both in environmental and in human terms, GenAI tools are very costly to build and train. They suffer from replication of societal biases, factual inaccuracies and troubling intellectual property rights infringement, thus using GenAI in a responsible manner is difficult. Other unresolved issues include privacy—uploading information into LLMs enables the information to be used for other purposes, and students and staff may be unaware of the risks of uploading student work or personal information, or of activity being tracked

across various systems (Bentley et al., 2023). There are also access issues given the huge quality difference between free-to-access tools and those which can be obtained on a subscription basis. Most AI services have limited functionality unless you pay, and some may not be able to afford this. Indeed, most students would quite reasonably feel that if AI access is required as part of their assessment, this should be covered by an institutional subscription. This is an issue both for individual students and for institutions as there will be an increasing divergence between institutions which can afford specialized AI, and those that cannot. Research is starting to suggest the emergence of a “digital divide,” where access to AI tools varies across student demographics; privileged students are more likely to be using GenAI than those from disadvantaged backgrounds, in addition to variations in use by gender and ethnicity (Freeman, 2024).

As GenAI becomes increasingly prevalent, there are concerns that young people from disadvantaged backgrounds may become more marginalized if they do not gain access to tools necessary for active engagement in the knowledge economy. Nonetheless, redesigning assessments for the age of AI is an increasingly urgent imperative—and one which offers opportunities for testing exciting new modes of assessment. Both teachers and students need to educate themselves in creative and ethical uses of GenAI and hone their skills of information literacy. As teachers, we need to rethink what we are assessing and why. We need to focus on effective assessments, balancing the need for authenticity and reliability. We need to be really clear with students about what uses of AI are acceptable in any given assessment. And we need to work with students to enhance the practical skills involving GenAI that they may need in the workplace as well as the critical thinking skills which they will need to challenge disinformation in the wider world.

## Discussion Questions

1. In relation to the subject and level you teach, identify key knowledge and skills and how you currently assess them. How can you adjust your assessment approaches to ensure they can be evaluated in a reliable and authentic manner?

## 302 Teaching and Learning in the Age of Generative AI

2. What ethical considerations might arise when using GenAI for assessment purposes in your context? How can you ensure fairness, transparency, and equity in evaluating student performance?
3. How might the incorporation of GenAI in assessment practices impact the development of critical thinking, creativity, and problem-solving skills in students? Are there potential risks of over-reliance on AI-generated assessments in hindering the cultivation of these essential competencies?
4. What implications does the use of GenAI for assessment have on the nature of teacher–student relationships and the role of educators in guiding and evaluating student learning?
5. There are a range of ways in which students might use GenAI in their work, as summarized below. Discuss with colleagues and students which of these would be considered acceptable use in your course and why.

### What Are Students Using AI For?

- a. Generating an assignment structure
- b. Getting AI to write a full essay
- c. Getting AI to give feedback on an essay they wrote
- d. Editing their work for grammar and punctuation
- e. Creating novel photographs and art
- f. Coding and making webpages
- g. Creating bullet points for slides
- h. Producing an entire slideshow presentation
- i. Generating reflective writing
- j. Getting AI to test them on memorized work
- k. Writing fiction or poems
- l. Drafting emails for faculty or employers

## References

Bentley C., Aicardi, C., Poveda, S., Cunha, L. M., Marzagao, D. K., Glover, R., Rigley, E., Walker, S., Compton, M., & Acar, O. (2023). *A framework for responsible AI education: A working paper*. SSRN Working Paper.

Biever, C. (2023). ChatGPT broke the Turing test—the race is on for new ways to assess AI. *Nature*, 619, 686–689. doi:10.1038/d41586-023-02361-7.

Black, P., & Wiliam, D. (1998). *Inside the black box: Raising standards through classroom assessment*. Granada Learning.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals. Vol. I: Cognitive domain*. David McKay Company.

Brown, R. (2023). *The AI Generation: How universities can prepare students for the changing world*. Demos. <https://demos.co.uk/wp-content/uploads/2023/11/The-AI-Generation-2.pdf>

Brown, T., Mann, B., Ryder, N., Subbiah, M., Kaplan, J. D., ... Amodei, D. (2020). Language models are few-shot learners. *Advances in Neural Information Processing Systems*, 33, 1877–1901. <https://papers.nips.cc/paper/2020/hash/1457c0d6bfcb4967418bf8ac142f64a-Abstract.html>

Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Powell, P., Westbrook, A., & Landes, N. (2006). *The BSCS 5E instructional model: Origins and effectiveness*. BSCS. <https://fremonths.org/ourpages/auto/2008/5/11/1210522036057/bscs5efullreport2006.pdf>

Campbell, M., & Jovanović, M. (2023). Detecting artificial intelligence: A new cyberarms race begins. *Computer*, 56, 100–105. doi:10.1109/MC.2023.3279446.

Care, E., & Kim, H. (2018). Assessment of twenty-first century skills: The issue of authenticity. In E. Care, P. Griffin, & M. Wilson (Eds.), *Assessment and teaching of 21st century skills: Educational assessment in an information age*. Springer. [https://doi.org/10.1007/978-3-319-65368-6\\_2](https://doi.org/10.1007/978-3-319-65368-6_2)

Cassidy, C. (2023, January 10). Australian universities to return to “pen and paper” exams after students caught using AI to write essays. *Guardian*. [www.theguardian.com/australia-news/2023/jan/10/universities-to-return-to-pen-and-paper-exams-after-students-caught-using-ai-to-write-essays](http://www.theguardian.com/australia-news/2023/jan/10/universities-to-return-to-pen-and-paper-exams-after-students-caught-using-ai-to-write-essays)

Chaka, C. (2023). Detecting AI content in responses generated by ChatGPT, YouChat, and Chatsonic: The case of five AI content detection tools. *Journal of Applied Learning and Teaching*, 6. doi:10.37074/jalt.2023.6.2.12.

Chan, C. K. Y., & Lee K. K. W. (2023). The AI generation gap: Are Gen Z students more interested in adopting generative AI such as ChatGPT in teaching and learning than their Gen X and Millennial generation teachers? *Smart Learning Environments*, 10(60). <https://doi.org/10.1186/s40561-023-00269-3>

Cheng, G. (2017). The impact of online automated feedback on students’ reflective journal writing in an EFL course. *The Internet and Higher Education*, 34, 18–27. <https://doi.org/10.1016/j.iheduc.2017.04.002>

Cheung, Y. L. (2015). Feedback from automated essay evaluation systems: A review of selected research. *TESL Reporter*, 48, 17.

Cohen, I., Liu, X., Hudson, M., Gillis, J., Cavalari, R., Romanczyk, R., Karmel, B., & Gardner, J. (2017). Level 2 screening with the PDD behavior

inventory: Subgroup profiles and implications for differential diagnosis. *Canadian Journal of School Psychology*, 32(3–4), 299–315. <https://doi.org/10.1177/0829573517721127>

Cohen, S. (1973). *Folk devils and moral panics: The creation of the mods and rockers*. Routledge.

Cotton, D. R. E., Cotton, P. A., & Shipway, J. R. (2024). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International*, 61(2), 228–239. <https://doi.org/10.1080/14703297.2023.2190148>

Darvishi, A., Khosravi, H., Sadiq, S., & Gasevic, D. (2022). Incorporating AI and learning analytics to build trustworthy peer assessment systems. *British Journal of Educational Technology*, 53, 844–875.

Dell'Acqua, F., McFowland, E., Mollick, E. R., Lifshitz-Assaf, H., Kellogg, K., Rajendran, S., Krayer, L., Cadelon, F., & Lakhani, K. R. (2023). Navigating the jagged technological frontier: Field experimental evidence of the effects of AI on knowledge worker productivity and quality. *Harvard Business School Technology & Operations Mgt. Unit Working Paper No. 24–013*. <http://dx.doi.org/10.2139/ssrn.4573321>

Denecke, K., Glauser, R., & Reichenpfader, D. (2023). Assessing the potential and risks of AI-based tools in higher education: Results from an e-survey and SWOT analysis. *Trends in Higher Education*, 2(4), 667–688. <https://doi.org/10.3390/higheredu2040039>

Downing, S. M. (2004). Reliability: On the reproducibility of assessment data. *Medical Education*, 38, 1006–1012.

Ellington, A. J. (2003). A meta-analysis of the effects of calculators on students' achievement and attitude levels in precollege mathematics classes. *Journal for Research in Mathematics Education*, 34, 433–463. doi:10.2307/30034795.

Foltýnek, T., Dlabolová, D., Anohina-Naumeca, A., Razi, S., Kravjar, J., Kamzola, L., Guerrero-Dib, J., Çelik, Ö., & Weber-Wulff, D. (2020). Testing of support tools for plagiarism detection. *International Journal of Educational Technology in Higher Education*, 17, 1–31.

Foltz, P. W. (2020). Practical considerations for using AI models in automated scoring of writing. In H. Jiao & R. Lissitz (Eds.), *Application of artificial intelligence to assessment* (pp. 101–113). Information Age Publishing.

Freeman, J. (2024). *Provide or punish? Students' views on generative AI in higher education*. HEPI Policy Note 51. [www.hepi.ac.uk/wp-content/uploads/2024/01/HEPI-Policy-Note-51.pdf](http://www.hepi.ac.uk/wp-content/uploads/2024/01/HEPI-Policy-Note-51.pdf)

Fyfe, P. (2023). How to cheat on your final paper: Assigning AI for student writing. *AI & Society*, 38(4), 1395–1405. <https://doi.org/10.1007/s00146-022-01397-z>

Gonzalez, V. H., Mattingly, S., Wilhelm, J., & Hemingson, D. (2024). Using artificial intelligence to grade practical laboratory examinations: Sacrificing students' learning experiences for saving time? *Anatomical Sciences Education*, 17, 932–936. <https://doi.org/10.1002/ase.2360>

Herbold, S., Hautli-Janisz, A., Heuer, U., Kikteva, Z., & Trautsch, A. (2023). A large-scale comparison of human-written versus ChatGPT-generated essays. *Scientific Reports*, 13, 18617. <https://doi.org/10.1038/s41598-023-45644-9>

Hern, A. (2022, December 4). AI bot ChatGPT stuns academics with essay-writing skills and usability. *The Guardian*. [www.theguardian.com/technology/2022/dec/04/ai-bot-chatgpt-stuns-academics-with-essay-writing-skills-and-usability](http://www.theguardian.com/technology/2022/dec/04/ai-bot-chatgpt-stuns-academics-with-essay-writing-skills-and-usability)

Hikida, M., & Taylor, L. A. (2023). "As the test collapses in": Teaching and learning amid high stakes testing in two urban elementary classrooms. *Urban Education*, 58(6), 1032–1060. <https://journals.sagepub.com/doi/10.1177/0042085920902263>

Holden, O. L., Norris, M. E., & Kuhlmeier, V. A. (2021). Academic integrity in online assessment: A research review. *Frontiers in Education*, 6. <https://doi.org/10.3389/feduc.2021.639814>

Hu, K. (2023, February 2). ChatGPT sets record for fastest-growing user base—analyst note. *Reuters*. [www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/](http://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/)

Jandric, P., & Knox, J. (2022). The postdigital turn: Philosophy, education, research. *Policy Futures in Education*, 20(7), 780–795.

Johnson, A. (2023, January 31). ChatGPT in schools: Here's where it's banned—and how it could potentially help students. *Forbes*. [www.forbes.com/sites/ariannajohnson/2023/01/18/chatgpt-in-schools-heres-where-its-banned-and-how-it-could-potentially-help-students](http://www.forbes.com/sites/ariannajohnson/2023/01/18/chatgpt-in-schools-heres-where-its-banned-and-how-it-could-potentially-help-students)

Jones, M. G., Jones, B. D., & Hargrove, T. Y. (2003). *The unintended consequences of high stakes testing*. Rowman & Littlefield Publishers.

Kaisar, S. (2023). Alternative assessment practices in higher education during the COVID-19 pandemic. *Journal of Learning and Educational Policy*, 3(5). <https://doi.org/10.55529/jlep.35.37.43>

Kim, J., Lee, H., & Cho, Y. H. (2022). Learning design to support student-AI collaboration: Perspectives of leading teachers for AI in education. *Education and Information Technologies*, 27(5), 6069–6104. <https://doi.org/10.1007/s10639-021-10831-6>

Kirst, M. (1991). Interview on assessment issues with Lorrie Shepard. *Educational Researcher*, 20(2), 21–23, 27.

Kohn, A. (2000). Burnt at the high stakes. *Journal of Teacher Education*, 51(4). <https://doi.org/10.1177/0022487100051004007>

Kozlowski, K. P. (2015). Culture or teacher bias? Racial and ethnic variation in student-teacher effort assessment match/mismatch. *Race and Social Problems*, 7, 43–59. <https://doi.org/10.1007/s12552-014-9138-x>

Kramm, N., & McKenna, S. (2023). AI amplifies the tough question: What is higher education really for? *Teaching in Higher Education*, 28, 2173–2178. doi:10.1080/13562517.2023.2263839.

Lewis, B., & Mukherjee, S. (2023, September 7). Generation AI: Education reluctantly embraces the bots. *Reuters*. [www.reuters.com/technology/generation-ai-education-reluctantly-embraces-bots-2023-09-07/](http://www.reuters.com/technology/generation-ai-education-reluctantly-embraces-bots-2023-09-07/)

Liang, W., Yuksekgonul, M., Mao, Y., Wu, E., & Zou, J. (2023). GPT detectors are biased against non-native English writers. *Patterns*, 4, 100779. doi:10.1016/j.patter.2023.100779.

Lo, C. K. (2023). What is the impact of ChatGPT on education? A rapid review of the literature. *Education Sciences*, 13(4), 410. <https://doi.org/10.3390/educsci13040410>

Madaus, G. F., & Clarke, M. (2001). The adverse impact of high stakes testing on minority students: Evidence from 100 years of test data. In G. Orfield & M. Kornhaber (Eds.), *Raising standards or raising barriers? Inequality and high stakes testing in public education*. The Century Foundation. <https://eric.ed.gov/?id=eD450183>

Medway, D., Roper, S., & Gillooly, L. (2018). Contract cheating in UK higher education: A covert investigation of essay mills. *British Educational Research Journal*, 44(3), 393–418.

Mitchell, A. (2023, December 26). Professor catches student cheating with ChatGPT: “I feel abject terror.” *New York Post*. <https://nypost.com/2022/12/26/students-using-chatgpt-to-cheat-professor-warns/>

Mollick, E. R., & Mollick, L. (2022). New modes of learning enabled by AI chatbots: Three methods and assignments. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.4300783>

Moorhouse, B. L., Yeo, M. A., & Wan, Y. (2023). Generative AI tools and assessment: Guidelines of the world’s top-ranking universities. *Computers and Education Open*, 5, 100151. doi:10.1016/j.caeo.2023.100151.

Murgia, M. (2023, November 13). OpenAI chief seeks new Microsoft funds to build “superintelligence.” *Financial Times*. [www.ft.com/content/dd9ba2f6-f509-42f0-8e97-4271c7b84ded](http://www.ft.com/content/dd9ba2f6-f509-42f0-8e97-4271c7b84ded)

Murtarella, G., Gregory, A., & Romentia, S. (2021). A conversation-based perspective for shaping ethical human-machine interactions: The particular challenge of chatbots. *Journal of Business Research*, 129, 927–935. doi:10.1016/j.jbusres.2020.09.018.

Nature. (2023, January 24). Tools such as ChatGPT threaten transparent science; here are our ground rules for their use. *Nature*, 613, 612. doi:10.1038/d41586-023-00191-1.

Newman, T., & Gulliver, M. (2023). *International students' digital experience: Phase 2, the experiences and expectations of international students studying in UK higher education*. JISC. <https://repository.jisc.ac.uk/9332/1/international-students-digital-experience-phase-two-experiences-and-expectations.pdf>

Newton, P., & Xiromeriti, M. (2024). ChatGPT performance on multiple choice question examinations in higher education: A pragmatic scoping review. *Assessment & Evaluation in Higher Education*, 49(6), 781–798. doi:10.1080/02602938.2023.2299059.

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education*, 31(2), 199–218. doi:10.1080/03075070600572090.

OpenAI. (2023). *GPT-4 technical report*. <https://arxiv.org/pdf/2303.08774.pdf>

Orben, A. (2020). The Sisyphean cycle of technology panics. *Perspectives on Psychological Science*, 15, 1143–1157. doi:10.1177/1745691620919372.

Palm, T. (2019). Performance assessment and authentic assessment: A conceptual analysis of the literature. *Practical Assessment, Research, and Evaluation*, 13(1), 4. <https://doi.org/10.7275/0qpc-ws45>

Phippen, A., & Bond, E. (2023). Fighting the tide—GPT and an alarming sense of déjà vu. In H. Jahankhani, A. Jamal, G. Brown, E. Sainidis, R. Fong, & U. J. Butt (Eds.), *AI, blockchain and self-sovereign identity in higher education* (pp. 37–51). Springer. doi:10.1007/978-3-031-33627-0\_2

Quality Assurance Agency for Higher Education. (2023). *Reconsidering assessment for the Chat GPT era: QAA advice on developing sustainable assessment strategies*. [www.qaa.ac.uk/docs/qaa/members/reconsidering-assessment-for-the-chat-gpt-era.pdf](http://www.qaa.ac.uk/docs/qaa/members/reconsidering-assessment-for-the-chat-gpt-era.pdf)

Ryan, R. M., & Weinstein, N. (2009). Undermining quality teaching and learning: A self-determination theory perspective on high-stakes testing. *Theory and Research in Education*, 7(2), 224–233.

Sawatzki, J., Schlippe, T., & Benner-Wickner, M. (2022). Deep learning techniques for automatic short answer grading: Predicting scores for English and German answers. In F. Xhafa (Ed.), *Lecture notes on data*

engineering and communications technologies (pp. 65–75). Springer. [https://doi.org/10.1007/978-981-16-7527-0\\_5](https://doi.org/10.1007/978-981-16-7527-0_5)

Shibani, A., Knight, S., & Buckingham Shum, S. (2020). Educator perspectives on learning analytics in classroom practice. *The Internet and Higher Education*, 46, 100730. <https://doi.org/10.1016/j.iheduc.2020.100730>

Shorey, S., Ang, E., Yap, J., Ng, E. D., Lau, S. T., & Chui, C. K. (2019). A virtual counselling application using artificial intelligence for communication skills training in nursing education: Development study. *Journal of Medical Internet Research*, 21(10), e14658. <https://doi.org/10.2196/14658>

Spann, P., & Kaufman, D. (2015). The negative effects of high-stakes testing. *Education Law and Policy*, 1(1), 1–14.

Stiggins, J. S. (1991). Facing challenges of a new era of educational assessment. *Applied Measurement in Education*, 4(4), 263–273. doi:10.1207/s15324818ame0404\_1

Swiecki, Z., Khosravi, H., Chen, G., Martinez-Maldonado, R., Lodge, J. M., Milligan, S., Selwyn, N., & Gašević, D. (2022). Assessment in the age of artificial intelligence. *Computers and Education: Artificial Intelligence*, 3, 100075. <https://doi.org/10.1016/j.caeari.2022.100075>

Weber-Wulff, D., Anohina-Naumeca, A., Bjelobaba, S., Foltýnek, T., Guerrero-Dib, J., Popoola, O., Šigut, P., & Waddington, L. (2023). Testing of detection tools for AI-generated text. *International Journal for Educational Integrity*, 19(26), 1–39. doi:10.1007/s40979-023-00146-z

Westfall, C. (2023, January 28). Educators battle plagiarism as 89% of students admit to using OpenAI's ChatGPT for homework. *Forbes*. [www.forbes.com/sites/chriswestfall/2023/01/28/educators-battle-plagiarism-as-89-of-students-admit-to-using-open-ais-chatgpt-for-homework](http://www.forbes.com/sites/chriswestfall/2023/01/28/educators-battle-plagiarism-as-89-of-students-admit-to-using-open-ais-chatgpt-for-homework)

Yan, Z., & Boud, D. (2021). Conceptualising assessment-as-learning. In Z. Yan & L. Yang (Eds.), *Assessment as learning: Maximising opportunities for student learning and achievement* (pp. 11–24). Routledge.

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education—where are the educators? *International Journal of Educational Technology in Higher Education*, 16(1), 39. <https://doi.org/10.1186/s41239-019-0171-0>

Zembylas, M. (2023). A decolonial approach to AI in higher education teaching and learning: Strategies for undoing the ethics of digital neo-colonialism. *Learning, Media and Technology*, 48(1), 25–37. doi:10.1080/17439884.2021.2010094.

# AI and the Digital Divide 14

*Renee Rottner, Lenore Porter, Jason Bock,  
Jordan Jannone, Rory Walsh Senerchia,  
Janet Ward, Joshua Whittinghill*

## Introduction

In this chapter, we will consider ways in which artificial intelligence (AI) holds the potential to either bridge or widen the educational divide, depending on how it is implemented. First, we review how access to technology, digital literacy, and biased algorithms contribute to the digital divide. Then we explore how AI can be tailored for different learners and the policy frameworks that are emerging around its use. For AI to be a force for good in education, its deployment should be guided by principles of equity and inclusiveness. This requires not only investments in technology, but also in training educators, developing ethical guidelines for AI use, and ensuring all students have equal access to AI-powered learning tools. By addressing these challenges, educators and policymakers can harness AI's potential to create a more equitable educational landscape.

AI in education includes generative AI (GenAI) tools in which users interact through natural language conversations (e.g., OpenAI's ChatGPT, Google's Gemini, Anthropic's Claude, and Microsoft's CoPilot). It also includes AI embedded in software and websites that utilize machine learning, such as Facebook's image tagging system and Google Translate. Furthermore, machine learning is used in speech recognition tools and automated grading systems, which enhance accessibility and efficiency in educational environments.

### *Defining the Digital Divide in Education*

The digital divide in education refers to the gap between students who have reliable access and the knowledge to use information and communication technologies (ICT), and those who do not (Ritzhaupt et al., 2020). ICT includes tools and resources used to communicate and process information, such as computers, the internet, and mobile devices. Access to digital resources can enhance the learning experience by offering interactive content, immediate access to information, and personalized learning paths that cater to individual student needs. However, students without internet access may struggle to complete research assignments that their peers can easily handle. This gap in access can widen the performance gap and significantly affect students' performance in classroom settings, where technology increasingly plays a vital role in learning (Miras et al., 2023).

Scholars have found that students with computer/internet access at home are 6–8% more likely to graduate from high school (Fairlie et al., 2010). Conversely, the lack of access can hinder students' ability to keep up with coursework or engage in digital learning activities. According to a national survey, 17% of US high school students cannot finish their homework because they lack computer/internet access at home (Anderson & Perrin, 2018). In addition to this "homework gap," the digital divide also hinders students' competence in increasingly common remote learning environments (Golden et al., 2023). Thus, when thinking about the possibilities for AI in education, we cannot ignore patterns of unequal access to ICTs. While education can be conducted without computers and the internet, AI entirely depends on it.

Before students even enter the classroom, however, the impact of the digital divide can be felt (Norman et al., 2022). College preparation programs that utilize digital tools, online resources for standardized testing practice, and the digital platforms used for college admissions processes can all be areas where the divide deepens existing educational inequalities. Students with limited or no access to technology at home may find themselves at a disadvantage, struggling to prepare for college entrance exams or to complete digital applications for college admission. For example, students with high-speed internet access at home perform better on standardized tests (Dettling et al., 2018). This

early disparity underscores the importance of addressing the digital divide not only within schools, but as part of a broader approach to educational equity. Even if students receive later access to ICT, their lack of training and experience with technology is likely to continue to limit their academic achievement (Miras et al., 2023).

The global impact of the COVID-19 pandemic has sharply highlighted the gap in digital access and skills. The sudden shift to remote learning was disruptive to all students, but it was not equal in its negative impact. For example, elementary school students from historically marginalized groups saw their standardized math and reading tests drop twice as much as Asian American and white students from 2019 to 2021 (Kuhfeld et al., 2023). Even before the pandemic, many students with physical disabilities abandoned their use of assistive technologies, due to complexity and cost (Alper & Raharinirina, 2006). Support systems for students with learning disabilities were originally designed for in-person instruction; however, the pandemic posed significant challenges in delivering this support effectively (Hirsch et al., 2022), as teachers often lacked guidance or training on available digital tools (Rice, 2022).

The digital divide is a multifaceted issue as education encompasses a range of factors that affect students from their early educational experiences through college admission and beyond (Ritzhaupt et al., 2020). Addressing this divide requires a holistic approach that considers the various stages of students' educational journeys (Vassilakopoulou & Hustad, 2023). By ensuring equitable access to digital tools and resources at each of these stages, educators and policymakers can work toward closing the digital divide and creating a more inclusive educational landscape.

### *Significance of Addressing Educational Inequities*

Addressing educational inequities, including the digital divide, can help foster a fair and inclusive society where every individual has the opportunity to succeed. The significance of tackling these disparities extends beyond the moral imperative of equity; it is also essential for economic and social development. Students who have equitable access to education and technology are better equipped to develop critical thinking

skills, engage in lifelong learning, and contribute to an innovation-driven economy. Furthermore, by ensuring that all students have access to educational opportunities, societies can harness a wider pool of talent and ideas, driving forward technological advancement and economic growth (Warschauer, 2003).

Moreover, educational inequities, if left unaddressed, perpetuate cycles of poverty and social exclusion. Children from disadvantaged backgrounds are more likely to face barriers in accessing quality education, including the digital tools and resources necessary for modern learning (Golden et al., 2023; Ragnedda & Muschert, 2013). This not only limits their potential for personal development and career opportunities, but also contributes to the broader issue of intergenerational poverty. By prioritizing equitable access to education, policymakers can break these cycles, offering future generations a stronger foundation for success, both personally and as contributors to their communities (Baxley & Boston, 2010; Mao & Sun, 2023).

Finally, addressing educational inequities is fundamental to building cohesive societies. Education plays a key role in fostering understanding, tolerance, and respect among diverse groups. When educational opportunities are evenly distributed, students from different backgrounds can share experiences and perspectives, building bridges across social and cultural divides (Degand, 2015; Sharif, 2011). This mutual understanding is the cornerstone of social cohesion, enabling societies to navigate the challenges of globalization and cultural integration. In this way, the effort to bridge educational divides is not just about enhancing individual outcomes but is also about strengthening the fabric of society itself (DiMaggio & Hargittai, 2001).

### *AI's Role in Bridging or Widening the Educational Divide*

The integration of AI in education presents both opportunities and challenges in the quest to bridge the educational divide. On the one hand, AI offers promising tools to personalize learning, making education more accessible and effective for students across various backgrounds. AI-powered platforms can adapt to individual learning style preferences and paces, offering customized feedback and support that cater to the unique needs of each student. This personalized

approach can help overcome traditional one-size-fits-all teaching methods, potentially leveling the playing field for students who might otherwise struggle in a conventional classroom setting (Luckin, 2018; Weller, 2018).

On the other hand, the deployment of AI in education also risks widening the existing divide if access to such technologies is uneven. Schools in affluent areas are more likely to have the resources to implement the latest AI tools, while underfunded schools may struggle to provide equal opportunities, lacking both the technology and the training to integrate AI effectively into their curriculum (Cobo & Rivas, 2023). This disparity means that the benefits of AI could accrue disproportionately to students already advantaged by their socio-economic status, further entrenching educational inequalities. The digital divide, in this scenario, becomes not just about access to technology, but access to the most advanced and effective educational tools available (Solís et al., 2023).

Beyond accessibility, there is also the issue of data privacy and ethical considerations. AI systems rely on vast amounts of data to function, and there are legitimate concerns about how student data are used and protected (Lainjo & Tsmouche, 2023). Ensuring that these systems are implemented in a way that respects students' privacy and autonomy is essential (Selwyn, 2019). Without careful oversight, the use of AI could contribute to surveillance cultures in schools, where every action of the less privileged student is monitored more closely, potentially leading to unintended negative consequences on their learning experiences and psychological well-being.

## How AI Exacerbates the Educational Divide

As AI continues to evolve and integrate into various aspects of education, it has the potential to amplify existing educational divides. Any benefits of AI use will rely on access to educational resources, digital tools, and literacy, while also introducing biases and technological barriers that disproportionately affect marginalized groups. By examining these critical areas, we can gain a deeper understanding of the complexities of AI in education and identify roadblocks to equitable implementation.

## *Connectivity Disparities: Assessing Access to High-Speed Internet and Educational Resources*

AI access fundamentally depends on the underlying network. Connectivity is a significant barrier to accessing educational resources globally, affecting students' ability to participate in digital learning environments (Van Dijk & Hacker, 2003). The divide between urban and rural areas is particularly pronounced, with urban centers often enjoying high-speed internet access, while rural regions lag behind due to infrastructural challenges and lack of investment. This phenomenon impacts students' access to online learning resources, digital libraries, and educational software, which are increasingly integral to modern education. Consequently, students in rural areas may struggle to complete online assignments, access supplementary learning materials, or participate in virtual classrooms, putting them at a disadvantage compared to their urban counterparts.

Socio-economic factors further exacerbate connectivity disparities, creating layers of inequality within both urban and rural contexts. The cost of internet access and digital devices can be prohibitive for low-income families, regardless of their geographical location (Wei & Hindman, 2011). This situation enables wealthier students to fully exploit online educational resources, while those from less affluent backgrounds face significant hindrances. Efforts to bridge these connectivity disparities have seen varied success across different countries (Hohlfeld et al., 2010). Some governments and non-governmental organizations (NGOs) have initiated programs to extend broadband access to underserved areas, distribute devices to students, and create more affordable internet plans. However, the effectiveness of these initiatives often hinges on coordination between public and private sectors, the availability of resources, and the long-term commitment to maintaining and upgrading infrastructure. Without sustained efforts, temporary solutions may not lead to lasting change.

Addressing the connectivity divide is essential for ensuring that all students have equal opportunities to benefit from digital education. This requires a broad approach that addresses not only the infrastructural challenges of providing high-speed internet access to rural and underserved areas, but also the socio-economic barriers that limit access to technology (Wei & Hindman, 2011). By prioritizing investments in

connectivity and making digital inclusion a central aspect of educational policy, governments and international organizations can take a significant step toward leveling the educational playing field for all students, regardless of their geographic or economic background (Warschauer, 2003).

### *Access to Digital Tools: Examining Disparities in Technology and Hardware Availability Across Schools and Communities*

AI access also depends on access to digital tools. The availability of computers, tablets, and smartphones, as well as the necessary infrastructure to support their use, varies widely across schools and communities (Nelson, 2021). In well-funded schools, often in more affluent communities, students may benefit from one-to-one device programs, cutting-edge computer labs, and high-speed internet connectivity. These resources facilitate a wide range of learning activities, from interactive digital textbooks to virtual reality experiences that bring complex subjects to life (Gottschalk & Weise, 2023). Conversely, schools in less affluent areas may struggle to provide students with access to even basic digital tools, limiting their ability to integrate technology into teaching and learning effectively (Nelson, 2021). Much depends on the budget and oversight within each school community. The availability of the tools and applications may be limited, as well as the type of support (e.g. professional development) provided to each instructor. Schools that lack funds or grants for faculty development may see their students fall further behind.

The disparity in access to digital tools extends beyond the school gates, affecting students' ability to engage with educational opportunities outside of school hours. In households with multiple children but only a single device, or no device at all, students may find it challenging to complete homework, conduct research, or participate in online learning platforms (Gottschalk & Weise, 2023; Signé, 2023). This situation is further complicated in areas with inadequate broadband infrastructure, where even if devices are available, slow or unreliable internet connections can render them nearly useless for educational purposes. As a result, the digital divide at home exacerbates

the educational inequalities observed in schools, with long-term implications for students' academic success and future opportunities.

The global perspective on this issue reveals a complex picture, with disparities not just between but also within countries. In some regions, efforts to improve access to digital tools have seen significant investment and collaboration between governments, non-profits, and private sector partners (Chang et al., 2004; Signé, 2023). Initiatives such as mobile internet classrooms, subsidized devices for students, and community internet access points aim to bridge the gap in technology availability. However, the success of these programs often hinges on their sustainability and the ongoing commitment to address the root causes of inequality (Hasan et al., 2016).

Moreover, the rapid pace of technological advancement means that disparities in access to digital tools are a moving target. As new technologies emerge, schools and communities that are already behind face the additional challenge of catching up to current standards while also preparing for future developments. This dynamic aspect of the digital divide requires continuous attention and adaptation from policymakers, educators, and stakeholders to ensure that efforts to close the gap remain relevant and effective. Addressing disparities in access to digital tools and infrastructure is a critical component of efforts to achieve educational equity. By prioritizing access to digital technology as a fundamental right for all students, society can take a significant step toward leveling the playing field and ensuring that every student has the opportunity to succeed in a digital world (Pierce & Cleary, 2024).

### *Digital Literacy Gaps: Understanding the Variations in Technological Knowledge Among Students and Educators*

The digital divide is not solely about access to devices or the internet. It is about understanding and effectively using technology. Digital literacy extends beyond the basic ability to navigate digital tools, encompassing data literacy—the capacity to read, interpret, create, and communicate data in context—as well as media literacy, which involves analyzing and critically evaluating media and its messages. These facets of digital

literacy are interconnected, influencing students' and educators' ability to effectively participate in a digital learning environment (Wang & Si, 2023). Understanding the variations in digital literacy among students and educators is critical for navigating the educational landscape.

Research highlights that students with high levels of digital, data, and media literacy gain a competitive edge in both academic and future professional settings (Christenbury et al., 2011; Hobbs, 2007; Pinto, 2014). Students benefit by being better positioned to critically assess information, engage with complex digital platforms, and produce creative digital outputs. Conversely, students lacking in these areas may find themselves at a disadvantage, struggling not only with the mechanics of technology, but also with the critical thinking skills necessary to navigate the digital world's vast and varied information landscape. This gap can lead to disparities in academic achievement and limit students' ability to participate in digitally mediated learning experiences (Brown, 1998; Hohlfeld et al., 2010).

AI literacy will be a necessary skill set when entering the workforce. As the use of AI continues to proliferate, the technological skills necessary to understand and use AI will be fundamental to achieving prominence in academic and professional fields. Unfortunately, with any technological growth or change, there are those groups that will benefit and those that will not. According to Yu et al. (2023), the development of AI in higher education is not evenly distributed across the world, as some countries (e.g., the United States and China, currently) are more prepared to understand and adapt to the constant advancements of AI. The variation in digital literacy levels among educators also significantly impacts the educational experience. Educators with digital, data, and media literacy skills are more likely to incorporate these elements into their teaching, thereby enhancing students' learning experiences and preparing them for the complexities of the digital age. Such educators can guide students through the maze of digital information, teaching them not just how to use technology, but how to question and create with it. On the other hand, educators who are less digitally literate may inadvertently narrow their students' learning opportunities, reinforcing rather than closing the digital divide.

Efforts to bridge the gaps in digital literacy must be comprehensive and sensitive to the varied experiences and requirements of both students and educators. Such initiatives could span targeted teacher

training, weaving digital literacy throughout the curriculum accessible to all learners, and fostering peer-led learning and mentorship opportunities. These strategies should go beyond merely facilitating technology use; they should also foster critical thinking about technology's societal impact, helping students navigate digital realms safely and responsibly. Additionally, critical pedagogy that encourages questioning and critical thinking about technology and media empowers both students and educators to navigate digital spaces thoughtfully and responsibly. Recognizing digital literacy as a fundamental skill, on par with traditional literacies like reading and writing, helps create educational environments that are both inclusive and effective.

### *Bias in AI Algorithms: Exploring the Impact of Bias on AI Systems*

Biases in AI algorithms can reinforce existing social inequalities, perpetuate stereotypes, and marginalize certain groups (Min, 2023; Noble, 2018). This bias is due to the data on which the AI is trained (Lee, 2018), which both reflects and reinforces existing social inequalities and the marginalization of certain groups. Baker and Hawn (2022) note that most AI systems statistically undersample indigenous, LGBTQIA+, and other socially minoritized peoples. Cultural and language barriers are other areas of concern when trying to assess wide-scale adoption of AI. Given the speed at which AI is spreading, it has become difficult to remedy the biases that exist within algorithms. Research continues to support claims that AI systems may be biased toward dominant languages or cultural norms, resulting in exclusionary practices that perpetuate disparities among marginalized communities (Kizilcec & Lee, 2022). Equity in access to AI is observed not only between countries and socio-economic status, but also among minority groups. For instance, persistent equity issues exist between White and Black populations in the United States, particularly in terms of financial disparities. The utilization of AI has the potential to exacerbate this divide. If the ability to engage with AI tools becomes a financial burden, it can price many people from underrepresented groups out of the market. Those who can purchase premium or paid plans gain access to additional features, enhanced functionality, or improved support. In

contrast, those limited to free versions face restricted opportunities to engage with, and benefit from, the technologies. Bridging this digital divide and addressing the affordability gap enhances equitable access and growth opportunities (Jones, 2024).

Underserved communities will continue to lag if they lack the means or knowledge to access AI. As Reich (2020) details, the benefits of most educational technologies go to those who are already most advantaged, especially in large-scale courses. Similarly, Jones (2024) explores the impact of AI in STEM fields, finding that individuals with limited to no exposure to AI experience significant disadvantages compared to their peers. The gap in AI knowledge hinders disadvantaged students from being able to not only compete in the classroom, but may also limit their ability to compete for scholarships, excel in STEM fields, and potentially secure admission to top-tier colleges and universities (Jones, 2024). This initiates a trickle-down effect, whereby disadvantaged student populations, unable to compete academically, will enter the workforce at a disadvantage. As the workforce increasingly relies on AI across various industries, these students will face persistent inequities, potentially limiting their career prospects, widening socio-economic disparities, and perpetuating a cycle of inequality.

### *Addressing Accessibility in AI Systems for Students with Disabilities and Diverse Backgrounds*

Regarding accessibility, AI is often considered a current or future vehicle for improving the lives of people with disabilities and reducing barriers that exist through technological innovations. However, as Guo and colleagues (2020) note, there is relatively little research on people with disabilities when it comes to training and algorithm building for AI systems. Computer vision, speech systems, text processing, and integrative AI are four domains by which AI can fail to support or recognize people with disabilities and, therefore, can further marginalize them (Guo et al., 2020). For example, automatic speech recognition systems are an essential tool for accessibility for people who are deaf or hard of hearing. However, the algorithm and technology used for speech input processing can be biased based on gender, age, and race. Further, individuals with disabilities that affect speech like deafness or

dysarthria may also have issues with the functionality of automatic speech recognition systems.

Though AI systems and educational technologies have the potential to lessen inequities and opportunity gaps, they can also unintentionally exacerbate inequities if not designed and tested with accessibility as a primary consideration. Students with disabilities frequently encounter obstacles when interacting with technology, limiting their ability to engage in curricular activities and assignments. It is important to consider the ethical implications of inclusivity, bias, privacy, error, expectation setting, simulated data, and social acceptability in the design and development of AI systems (Morris, 2020). This ensures that systems are designed with marginalized populations at the forefront. Failing to prioritize accessibility embedded within the design of emerging educational technologies can lead to the exclusion and marginalization of students with disabilities, further widening the educational divide.

Currently, AI-driven accessibility solutions often focus primarily on visual impairments (Chemnad & Othman, 2024), leaving students with other types of disabilities underserved. Research and AI systems that address challenges for people with speech and hearing impairments, autism spectrum disorder, neurological disorders, and motor impairments are notably lacking. This imbalance in research and development can result in students with disabilities struggling to utilize and benefit from AI-powered educational tools. Insufficient technology to support students with disabilities often requires educators to develop multiple access plans, which can lead to inconsistent learning experiences and exacerbate existing barriers.

To address access, equity, and inclusion barriers, an equity-informed approach by educators, policymakers, and community stakeholders is needed to ensure AI benefits all students and families, regardless of their background or resources. An example of this approach is Bram De Buyser's development of *goblin.tools*, a collection of small, simple tools designed to support neurodivergent individuals with overwhelming tasks (De Buyser, 2024).

## How AI Could Bridge the Educational Divide

With proper application, AI tools have the potential to significantly reduce the educational and digital divide. Achieving this requires

comprehensive training for both instructors and students to ensure the effective use of these technologies. Additionally, subsidies could extend internet access and AI tools beyond free trials, making them accessible to more communities. Funding for research and regulation is also needed to combat data biases and ensure ethical AI development and deployment. Although AI technology is advancing rapidly, a more deliberate and thoughtful approach can maximize its benefits and empower diverse learners.

### *Empowering Diverse Learners with AI*

- 1. Personalized Learning and Coaching.** AI-driven adaptive learning platforms can tailor educational experiences to individual student needs, promoting mastery and inclusivity. Tools like Khan Academy and Duolingo use machine learning algorithms to adapt content based on learners' progress, ensuring personalized lessons and targeted support. Aside from differentiating the content presented to students, GenAI can also be leveraged to increase the readability of curricular content at large scales to be accessible to all students regardless of reading level, especially emerging readers. For example, GenAI can offer personalized feedback on writing, help students draft and revise their work, and provide additional examples or exercises that can extend the class lecture. As students rely less on educators as the primary source of knowledge, teachers can focus on developing essential skills such as critical assessment, problem-solving, and creativity.
- 2. Inclusion for Non-Native Language Speakers.** AI-powered translation and language learning tools can significantly support non-native speakers. For instance, Google Translate and DeepL provide real-time language translation, breaking down language barriers and facilitating communication. Additionally, GenAI can assist non-native English-speaking students and educators in scholarly writing, enhancing their ability to contribute to research, much of which is published in English. These AI tools, often based on English language data, can provide feedback on grammar, style, and clarity, helping users improve their written English. Those who have faced barriers due to language limitations or lack of exposure can particularly benefit from this AI-driven feedback and support.

3. **Assisting Students with Disabilities.** AI solutions can enhance accessibility and personalized learning for students with disabilities. AI-driven technologies, such as screen readers and speech recognition software, enable individuals with visual impairments to access and interact with digital content by converting text on screens into speech or Braille. Gesture-based interfaces and other assistive technologies also play a vital role in ensuring that students with physical disabilities can engage with educational materials. For example, popular GenAI tools, such as ChatGPT and Google's Gemini, can read speech and video, further supporting diverse learning needs.
4. **Skill Development for Employability.** AI-powered job platforms and skill development tools can bridge socio-economic gaps by providing equal access to employment opportunities and educational resources. Platforms like LinkedIn and Coursera use algorithms to match job seekers with suitable opportunities and recommend relevant courses. Additionally, tools like VMock, an AI-driven resume review platform, provide personalized feedback on resumes, helping individuals enhance their employability. These AI tools assist marginalized groups in acquiring new skills, improving their resumes, and accessing job opportunities that may otherwise be out of reach.
5. **Enhancing Collaborative Learning.** AI can significantly enhance collaborative learning by facilitating group projects, discussions, and peer-to-peer interactions. Tools like Microsoft Teams and Slack use AI to organize and manage group work, providing features like intelligent scheduling, automated task tracking, and real-time document collaboration. AI-driven platforms can also analyze group dynamics and participation, offering insights and feedback to ensure equitable contributions from all members. Additionally, AI can match students with compatible peers for study groups based on their learning style preferences and interests, fostering a more effective and personalized collaborative learning environment.

Although AI technologies are rapidly evolving and new tools are constantly being introduced, here is a list of some AI tools that illustrate the ways in which AI can benefit diverse students:

- **Carnegie Learning:** Provides personalized math education ([www.carnegielearning.com](http://www.carnegielearning.com))

- **Coursera:** An online learning platform that leverages AI for course recommendations and personalized learning paths ([www.coursera.org](http://www.coursera.org))
- **DreamBox:** An adaptive K-8 math platform that tailors content to individual student needs ([www.dreambox.com](http://www.dreambox.com))
- **Duolingo:** A language learning platform that uses AI to personalize lessons and track progress ([www.duolingo.com](http://www.duolingo.com))
- **Edmentum:** An AI-powered learning platform for personalized education ([www.edmentum.com](http://www.edmentum.com))
- **Kaltura:** An AI-powered video platform for educational content creation and distribution ([www.kaltura.com](http://www.kaltura.com))
- **Querium:** An AI-powered tutoring platform for math and science subjects ([www.querium.com](http://www.querium.com))
- **Smart Sparrow:** An adaptive e-learning platform ([www.smartsparrow.com](http://www.smartsparrow.com))
- **Squirrel AI:** A personalized adaptive learning platform for K-12 students ([www.squirrelai.com](http://www.squirrelai.com))

Integrating AI into education can create a more inclusive learning environment that addresses diverse student needs. AI enables educators to offer accessible and personalized learning experiences. Imagine lessons that adapt to each student's progress and provide tailored feedback. AI tools can assist non-native speakers in learning new languages. Other tools enhance employability skills. Additionally, AI supports students with disabilities through text, video, and voice commands. These advancements are transforming how we learn and interact with knowledge. Embracing these tools will prepare students to succeed in a world where AI is increasingly embedded.

## Future Directions

### *Legislative Frameworks*

The emergence of AI in education presents unique opportunities to enhance learning outcomes and accessibility. However, AI may also exacerbate existing educational disparities and introduce new forms of bias, which necessitates comprehensive legislative frameworks to guide its ethical and equitable use (Gottschalk & Weise, 2023). Governments

around the world are working on ways to regulate and guide the development of AI technology. While legislative progress lags far behind technical advancements, several governmental policies have been proposed or adopted. Notable examples include the European Union's *Artificial Intelligence Act of 2024* (introduced in 2019); and the United States' *Algorithmic Accountability Act* (introduced in 2019), which has not yet passed in Congress. Other efforts include voluntary guidance on AI use, such as Singapore's *Model AI Governance Framework* (introduced in 2019), and the United States' *National Blueprint for an AI Bill of Rights* (introduced in 2022). Effective regulatory approaches must address both the opportunities and challenges posed by AI technologies, ensuring that the benefits of AI are accessible to all students regardless of their socio-economic background (Warschauer, 2003).

Policy interventions should focus on bridging the digital divide by providing robust infrastructure and ensuring universal access to AI-powered educational tools. This includes funding for hardware, software, and internet access, particularly in underprivileged and rural areas, to prevent the emergence of a two-tiered education system where only affluent students benefit from AI advancements (Pierce & Cleary, 2024). Governments and educational institutions can collaborate to implement these infrastructures, creating policies to subsidize AI technology in schools and provide training for teachers that lack the necessary resources. Furthermore, legislation must address privacy concerns and data protection where AI is concerned in education. The collection and analysis of vast amounts of student data, while beneficial for personalized learning, raise significant concerns about privacy and consent. Regulations need to establish clear guidelines on data usage, ensure transparency and student data protection, and prevent misuse that could harm students or disproportionately target vulnerable populations (Selwyn, 2019).

To combat the potential for bias in AI algorithms, regulatory frameworks must require the development and testing of AI technologies to be inclusive and representative of diverse student populations. This involves mandating that AI systems are routinely audited for biases and that the results of these audits are publicly reported. Policies should encourage the participation of diverse groups in AI development processes to mitigate the risks of encoding discriminatory practices into AI systems (Noble, 2018). Lastly, there is a need for continuous

professional development for educators. Legislative policies should support training programs that enable teachers to effectively integrate AI tools into their teaching practices to help ensure they are using these tools effectively and critically assessing their impacts on educational equity (Luckin, 2018). Legislative frameworks governing the use of AI in education must be comprehensive and forward-thinking, addressing access, privacy, bias, and professional training. By establishing clear guidelines and support structures, policymakers can ensure that AI serves as a tool for enhancing educational outcomes equitably across all segments of society and is developed to eliminate biases and discrimination. At the same time, legislation, at its core, must speak to access, equity, diversity, and inclusion.

### *Open Questions and Issues*

This chapter explored the multifaceted impact of AI on the educational landscape, particularly its role in addressing or exacerbating the digital divide. AI holds a dual potential. It can significantly enhance educational accessibility and efficiency through personalized learning experiences, yet it also poses risks of widening existing disparities if not equitably distributed (Luckin, 2018; Weller, 2018). As AI becomes integrated into educational systems, its benefits can be designed to reach all students, irrespective of their socio-economic backgrounds (Dewan & Riggins, 2005). Moreover, the ethical implications of AI, including concerns about data privacy and algorithmic bias, must be meticulously managed. Ensuring that AI systems are transparent and inclusive can prevent them from reinforcing existing social inequalities (Lainjo & Tsmouche, 2023; Noble, 2018). This calls for a robust framework that addresses both the technical aspects of AI and the socio-cultural dimensions of its application in education.

The drive toward digital equity is not merely a technological challenge, but a complex socio-political issue that requires comprehensive policy interventions and collaborative efforts among various stakeholders (Warschauer, 2003). Governments and educational institutions need to invest in infrastructure that supports equitable access to AI tools and promote digital literacy to ensure that students can effectively utilize these technologies (Pierce & Cleary, 2024). As

as this technology evolves, we offer the following questions to guide future research and policy:

- How can *students* use AI to personalize their learning, and in what ways might it help level the educational playing field? Conversely, what risks does AI pose in potentially deepening educational inequalities?
- How can *educational and instructional technologists* mitigate the challenges of bias, representativeness, and accessibility inherent in AI tools? How do biases in AI algorithms impact educational opportunities for marginalized student groups? What measures can be implemented to mitigate these biases?
- How can *teachers and administrators* gain the skills to integrate AI tools in their schools? Considering the variations in digital literacy among educators, how important is professional development in digital skills for teachers in reducing the educational divide? What aspects of AI use and policy should be left to teachers and what should be centralized by the school or district?
- How can *stakeholders*—including students, educators, policymakers, and technologists—work together to ensure that AI serves as a force for good in reducing educational disparities and supporting students with disabilities or differences?

In conclusion, the path to an inclusive educational system through AI will involve addressing the multidimensional aspects of the digital divide. However, this requires that stakeholders begin to work together to transform educational outcomes and contribute to the broader social goal of reducing inequalities and promoting inclusivity in the digital age. Addressing the digital divide is not just about providing access to technology, but about ensuring that all individuals have the skills and knowledge to use it in a way that enriches their learning and their lives. This means moving beyond superficial engagement with digital tools to foster a deeper understanding of how technology mediates our understanding of the world and our interactions with others.

## Discussion Questions

1. In what ways can GenAI bridge, or widen, the digital divide at the following levels: classroom, school, district?

2. How do digital literacy, technology access, and physical abilities affect students' AI use?
3. What agency do educators have in their classroom environment to mitigate the impacts of bias in AI algorithms on their students?
4. Consider the educational policies or standards that currently govern AI use. In what ways is that guidance either lacking or unclear? How can it be improved?
5. What skills or competencies in digital literacy should educators focus on developing in order to effectively be able to teach digital literacy to their students?

## References

Alper, S., & Raharinirina, S. (2006). Assistive technology for individuals with disabilities: A review and synthesis of the literature. *Journal of Special Education Technology*, 21(2), 47–64. <https://doi.org/10.1177/016264340602100204>

Anderson, M., & Perrin, A. (2018). Nearly one in five teens can't always finish their homework because of the digital divide. *Pew Research Center*. [www.pewresearch.org/short-reads/2018/10/26/](http://www.pewresearch.org/short-reads/2018/10/26/)

Baker, R. S., & Hawn, A. (2022). Algorithmic bias in education. *International Journal of Artificial Intelligence in Education*, 32(1), 1–41. <https://doi.org/10.1007/s40593-021-00285-9>

Baxley, T. P., & Boston, G. H. (2010). Classroom inequity and the literacy experiences of Black adolescent girls. In J. Zajda (Ed.), *Globalization, education and social justice* (pp. 145–159). Springer. [https://doi.org/10.1007/978-90-481-3221-8\\_10](https://doi.org/10.1007/978-90-481-3221-8_10)

Brown, J. A. (1998). Media literacy perspectives. *Journal of Communication*, 48(1), 44–57. <https://doi.org/10.1111/j.1460-2466.1998.tb02736.x>

Chang, B. L., Bakken, S., Brown, S. S., Houston, T. K., Kreps, G. L., Kukafka, R., & Stavri, P. Z. (2004). Bridging the digital divide: Reaching vulnerable populations. *Journal of the American Medical Informatics Association*, 11(6), 448–457. <https://doi.org/10.1197/jamia.M1535>

Chemnad, K., & Othman, A. (2024). Digital accessibility in the era of artificial intelligence: Bibliometric analysis and systematic review. *Frontiers in Artificial Intelligence*, 7. <https://doi.org/10.3389/frai.2024.1349668>

Christenbury, L., Bomer, R., & Smagorinsky, P. (Eds.). (2011). *Handbook of adolescent literacy research*. Guilford Press.

Cobo, C., & Rivas, A. (Eds.). (2023). *The new digital education policy landscape: From education systems to platforms*. Taylor & Francis.

De Buyser, B. (2024). *About GoblinTools*. <https://goblin.tools/About>

Degand, D. (2015). A phenomenological multi-case study about social success skills, aspirations, and related media experiences. *The Qualitative Report*, 20(6), 872–900. <https://nsuworks.nova.edu/tqr/vol20/iss6/13/>

Detting, L. J., Goodman, S., & Smith, J. (2018). Every little bit counts: The impact of high-speed internet on the transition to college. *Review of Economics and Statistics*, 100(2), 260–273. [https://doi.org/10.1162/REST\\_a\\_00712](https://doi.org/10.1162/REST_a_00712)

Dewan, S., & Riggins, F. J. (2005). The digital divide: Current and future research directions. *Journal of the Association for Information Systems*, 6(12), 298–337. <https://doi.org/10.17705/1jais.00074>

DiMaggio, P., & Hargittai, E. (2001). *From the “digital divide” to “digital inequality”: Studying internet use as penetration increases*. Working Paper 15. Center for Arts and Cultural Policy Studies, Woodrow Wilson School, Princeton University.

Fairlie, R. W., Beltran, D. O., & Das, K. K. (2010). Home computers and educational outcomes: Evidence from the NLSY97 and CPS. *Economic Inquiry*, 48(3), 771–792. <https://doi.org/10.1111/j.1465-7295.2009.00218.x>

Golden, A. R., Srisarajivakul, E. N., Hasselle, A. J., Pfund, R. A., & Knox, J. (2023). What was a gap is now a chasm: Remote schooling, the digital divide, and educational inequities resulting from the COVID-19 pandemic. *Current Opinion in Psychology*, 52, 101632. <https://doi.org/10.1016/j.cop.2023.101632>

Gottschalk, F., & Weise, C. (2023). *Digital equity and inclusion in education: An overview of practice and policy in OECD countries*. OECD Education Working Papers, No. 299. OECD Publishing. <https://doi.org/10.1787/7cb15030-en>

Guo, A., Kamar, E., Vaughan, J. W., Wallach, H., & Morris, M. R. (2020). Toward fairness in AI for people with disabilities: A research roadmap. *ACM SIGACCESS Accessibility and Computing*, 125(2), 1. <https://doi.org/10.1145/3386296.338629>

Hasan, N., Ashraf, M. M., Abdullah, A. B. M., & Murad, M. W. (2016). Introducing mobile internet as a learning assistant for secondary and higher secondary students. *The Journal of Developing Areas*, 50(5), 41–55. <https://doi.org/10.1353/jda.2016.0061>

Hirsch, S. E., Bruhn, A. L., McDaniel, S., & Mathews, H. M. (2022). A survey of educators serving students with emotional and behavioral disorders during the COVID-19 pandemic. *Behavioral Disorders*, 47(2), 95–107. <https://doi.org/10.1177/019874292110167>

Hobbs, R. (2007). *Reading the media: Media literacy in high school English*. Teachers College Press, Columbia University.

Hohlfeld, T. N., Ritzhaupt, A. D., & Barron, A. E. (2010). Connecting schools, community, and family with ICT: Four-year trends related to school level and SES of public schools in Florida. *Computers & Education*, 55(1), 391–405. <https://doi.org/10.1016/j.compedu.2010.02.004>

Jones, N. (2024, February 13). Bridging the digital divide: How AI is leaving Black youth behind. *LinkedIn*. [www.linkedin.com/pulse/bridging-digital-divide-how-ai-leaving-black-youth-naketa-jones-edd-nczxc/](https://www.linkedin.com/pulse/bridging-digital-divide-how-ai-leaving-black-youth-naketa-jones-edd-nczxc/)

Kizilcec, R. F., & Lee, H. (2022). Algorithmic fairness in education. In W. Holmes & K. Porayska-Pomsta (Eds.), *Ethics in Artificial Intelligence in Education* (pp. 55–72). Taylor & Francis.

Kuhfeld, M., Lewis, K., & Peltier, T. (2023). Reading achievement declines during the COVID-19 pandemic: Evidence from 5 million US students in grades 3–8. *Reading and Writing*, 36(2), 245–261. <https://doi.org/10.1007/s11145-022-10345-8>

Lainjo, B., & Tsmouche, H. (2023). The impact of artificial intelligence on higher learning institutions. *International Journal of Education, Teaching, and Social Sciences*, 3(2), 96–113. <https://doi.org/10.47747/ijets.v3i2.1028>

Lee, N. T. (2018). Detecting racial bias in algorithms and machine learning. *Journal of Information, Communication and Ethics in Society*, 16(3), 252–260. <https://doi.org/10.1108/JICES-06-2018-0056>

Luckin, R. (2018). *Machine learning and human intelligence: The future of education for the 21st century*. UCL IOE Press.

Mao, Z., & Sun, Y. (2023). Unraveling the complexities of educational inequalities: Challenges and strategies for a more equitable future. *Frontiers in Educational Research*, 6(20), 1–12. <https://doi.org/10.25236/FER.2023.062029>

Min, A. (2023). Artificial intelligence and bias: Challenges, implications, and remedies. *Journal of Social Research*, 2(11), 3808–3817. <https://doi.org/10.55324/josr.v2i11.1477>

Miras, S., Ruiz-Bañuls, M., Gómez-Trigueros, I. M., & Mateo-Guillén, C. (2023). Implications of the digital divide: A systematic review of its impact in the educational field. *Journal of Technology and Science Education*, 13(3), 936–950. <https://doi.org/10.3926/jotse.2249>

Morris, M. R. (2020). AI and accessibility: A discussion of ethical considerations. *Communications of the ACM*, 63(6), 35–37. <https://doi.org/10.48550/arXiv.1908.08939>

Nelson, R. L. (2021). *A program proposal to end the digital divide at California State University, Bakersfield* (Master's thesis, California State University, Bakersfield).

Noble, S. U. (2018). *Algorithms of oppression: How search engines reinforce racism*. New York University Press.

Norman, H., Adnan, N. H., Nordin, N., Ally, M., & Tsinakos, A. (2022). The educational digital divide for vulnerable students in the pandemic: Towards the New Agenda 2030. *Sustainability*, 14(16), 10332. <https://doi.org/10.3390/su141610332>

Pierce, G. L., & Cleary, P. F. (2024). The persistent educational digital divide and its impact on societal inequality. *PLOS One*, 19(4), e0286795. <https://doi.org/10.1371/journal.pone.0286795>

Pinto, M. (2014). Empowering citizens through media literacy education. *Media Literacy and Academic Research*. Council of Europe. <https://rm.coe.int/16806a2e04>

Ragnedda, M., & Muschert, G. W. (2013). *The digital divide: The internet and social inequality in international perspective*. Routledge.

Reich, J. (2020). *Failure to disrupt: Why technology alone can't transform education*. Harvard University Press.

Rice, M. F. (2022). Special education teachers' use of technologies during the COVID-19 era (Spring 2020—Fall 2021). *TechTrends*, 66(2), 310–326. <https://doi.org/10.1007/s11528-022-00700-5>

Ritzhaupt, A. D., Cheng, L., Luo, W., & Hohlfeld, T. N. (2020). The digital divide in formal educational settings: The past, present, and future relevance. In M. J. Bishop, E. Boling, J. Elen, & V. Svihlá (Eds.), *Handbook of research in educational communications and technology: Learning design* (pp. 483–504). Springer. [https://doi.org/10.1007/978-3-030-36119-8\\_23](https://doi.org/10.1007/978-3-030-36119-8_23)

Selwyn, N. (2019). *Should robots replace teachers? AI and the future of education*. John Wiley & Sons.

Sharif, N. (2011). *Perceptions of social mobility in community college scholars at Bucknell University* (Master's thesis, Bucknell University).

Signé, L. (2023). *Fixing the global digital divide and digital access gap*. Brookings. <https://policycommons.net/artifacts/4514799/fixing-the-global-digital-divide-and-digital-access-gap/5324545/>

Solís, M. W. M. V., Ríos, C. A. G., Hermida, C. E. C., Alencastre, J. L. A., & Tovalin-Ahumada, J. H. (2023). The impact of artificial intelligence on higher education: A sociological perspective. *Journal of Namibian Studies: History Politics Culture*, 33, 3284–3290. <https://doi.org/10.59670/jns.v33i.969>

Van Dijk, J., & Hacker, K. (2003). The digital divide as a complex and dynamic phenomenon. *The Information Society*, 19(4), 315–326. <https://doi.org/10.1080/01972240309487>

Vassilakopoulou, P., & Hustad, E. (2023). Bridging digital divides: A literature review and research agenda for information systems research. *Information Systems Frontiers*, 25(3), 955–969. <https://doi.org/10.1007/s10796-020-10096-3>

Wang, C., & Si, L. (2023). A bibliometric analysis of digital literacy research from 1990 to 2022 and research on emerging themes during the COVID-19 pandemic. *Sustainability*, 15(7), 5769. <https://doi.org/10.3390/su15075769>

Warschauer, M. (2003). *Technology and social inclusion: Rethinking the digital divide*. MIT Press.

Wei, L., & Hindman, D. B. (2011). Does the digital divide matter more? Comparing the effects of new media and old media use on the education-based knowledge gap. *Mass Communication and Society*, 14(2), 216–235. <https://doi.org/10.1080/15205431003642707>

Weller, M. (2018). Twenty years of EdTech. *Educause Review Online*, 53(4), 34–48.

Yu, D., Rosenfeld, H., & Gupta, A. (2023, January 16). The “AI divide” between the Global North and the Global South. *World Economic Forum*. [www.weforum.org/agenda/2023/01/davos23-ai-divide-global-north-global-south/](http://www.weforum.org/agenda/2023/01/davos23-ai-divide-global-north-global-south/)

# Defining Key Workplace Competencies in the AI Era: A Framework for AI-Powered Education **15**

*Peter Cardon, Bryan Marshall*

## Introduction

With the advent of GenAI in the past few years, the AI Era is poised to disrupt knowledge work. This provides an opportunity for educators to adapt their coursework to more closely align with the emerging needs of the workplace. To do so requires educators to understand the distinctive aspects of the AI Era, recognize the emerging competencies valued by employers, and develop strategies to align teaching and learning with these evolving priorities. Therefore, this chapter will address three basic questions: What are the fundamental characteristics of the AI Era? What competencies will knowledge workers need in the AI Era? How can educators support the growth of university students and early-career professionals in this shifting environment? The emerging work environment is marked by significant uncertainty. This chapter aims to provide a broad set of principles that educators can use to incrementally, but regularly, align coursework and assignments with the career needs of students.

## Characteristics of the Emerging AI Era

The notion of AI goes back roughly 75 years, so it is not conceptually new, and AI technologies have continued to advance over many decades. While most AI applications have operated behind the scenes without much public attention, high-profile accomplishments of AI have included IBM's Deep Blue beating world champion Gary Kasparov in chess in 1997, IBM's Watson beating champion contestants in Jeopardy! in 2011, and Google's Alpha Go beating world champion Ke Jie in Chinese Go (a game far more complex than chess) in 2017 (Anyoha, 2017). Technologists suggest we are entering a new AI Era (Cardon, Fleischmann et al., 2023; Nerozzi, 2023), signaled by the release of Open AI's ChatGPT 3.5 in November 2022. This era is distinctive for the following reasons:

- 1. AI is now available for nearly any knowledge worker on the planet.** Any professional can use AI for common communication and other work tasks. Using tools such as ChatGPT, Anthropic's Claude, Google's Gemini, and Microsoft's CoPilot requires no technical knowledge of AI. Each of these platforms is available in less powerful free versions and more powerful paid versions. The free versions are capable of high-quality work, and the paid versions are not cost prohibitive for most knowledge workers in developed countries. In short, high-quality AI is accessible to anyone who wants to use it.
- 2. AI is widely accepted for professional use.** By July of 2023, research showed that most business professionals were already using AI in their work to help write messages and reports, summarize information, translate, create images and video, and many other tasks (Cardon, Fleischmann et al., 2023). In March 2024, Microsoft and LinkedIn commissioned an independent research firm, Edelman Data & Intelligence, to examine AI usage among 31,000 global knowledge workers from the United States, the United Kingdom, Germany, France, India, Singapore, Australia, and Brazil (Microsoft & LinkedIn, 2024). Further, Microsoft and LinkedIn used data from LinkedIn's online employment platform that covers over 1 billion members, 67 million companies, and 134,000 schools to evaluate AI aptitude skills and projected skills changes. According to this research, 75% of global knowledge workers were estimated to be

using AI in their work. Among Gen Z professionals the adoption rate is at 85% (Microsoft & LinkedIn, 2024). In other words, there is already a critical mass of AI users.

3. **AI makes professionals more efficient AND effective.** Perhaps most importantly, AI works well for many complex work tasks. Studies reveal that AI helps highly skilled knowledge workers produce better work and do it faster. For example, a study of 758 BCG consultants showed that those who used AI on a series of 18 high-level consulting tasks performed work 25% more quickly, completed 12% more tasks, and produced 40% higher quality as determined by blind review judges (Dell'Acqua et al., 2023). A Microsoft and LinkedIn report (2024) identified the following benefits reported by professionals: AI saves time (90%), helps them focus on more important work (85%), helps them be more creative (85%), and helps them enjoy their work more (83%). The researchers also found nearly 80% of business leaders believed their company needs to adopt AI to be competitive. Similarly, approximately 66% said they would not hire someone without AI skills. Importantly, 71% said that they would rather hire a less experienced professional with AI skills than a more experienced one without AI skills (Microsoft & LinkedIn, 2024).
4. **AI tools continue to rapidly improve in performance and capabilities.** Since its launch, ChatGPT has improved rapidly in a short period. For example, ChatGPT initially scored 53.1% on average on the CPA exam in early 2023, yet scored 85.1% on average by July 2023 (Tyson, 2023). ChatGPT was initially critiqued as frequently producing hallucinations, not providing current information, and only interacting in text. At this point in time, generative AI platforms continue to be limited in many ways but continue to progress. For example, ChatGPT's hallucination rate is now at approximately 3% (Metz, 2023). Also, it now has access to current information online, and is multimodal, with the ability to see, hear, and speak (ChatGPT, 2023). With major tech firms, such as Google, Microsoft, Facebook, and Salesforce, to name a few, investing billions of dollars in AI, the rapid growth in computing power, data, and algorithms is fueling exponential growth in AI capabilities (Henshall, 2023).
5. **AI tools continue to be integrated more seamlessly into productivity software.** A major trend that continues to drive higher AI

usage among knowledge workers is the integration of AI platforms directly into productivity suites. While many knowledge workers will continue to work directly in platforms such as ChatGPT and Claude, most will likely access AI tools directly in word processing, spreadsheet, slide decks, CRMs, and other tools. For example, Microsoft has created CoPilot, an AI-powered digital assistant that integrates AI tools and a user's data to help create content in various Microsoft applications. Roughly 78% of AI users bring their own AI tools to work (Microsoft & LinkedIn, 2024).

6. **AI tools increasingly display humanlike abilities.** Most people recognize that AI systems can display humanlike cognitive intelligence. Former Chief Business Officer at Google, Mo Gawdat, even predicts AI will be one billion times smarter than humans by 2045 (Gawdat, 2021). Yet, fewer people recognize other forms of intelligence that AI is increasingly adept at. McKinsey Global Institute, the research wing of the most well-known consulting firm in the world, projects that AI reached human-level performance in creativity, logical reasoning, and natural-language understanding in 2023; will reach human-level social and emotional output by 2025; and human-level social and emotional reasoning by 2026 (Chui et al., 2023). In fact, by April 2023, ChatGPT responses to patient questions were considered superior to those provided by actual doctors. ChatGPT scored 21% higher in response quality and demonstrated a 41% increase in empathy (Ayers et al., 2023).

As impressive as ChatGPT and other AI tools are in generating large blocks of human-sounding text and creating audio and images, experienced users recognize their limitations. It is well documented that GenAI tools are prone to significant errors (Metz, 2023). A common human tendency is to overlook the profound, long-term impacts of technological change. As Mollick (2024) noted, this is encapsulated by Amara's Law: "We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run." As far as changes in valued workplace skills, we are likely to see incremental developments in the next few years and profound and disruptive changes within five to ten years. Professionals who learn to use AI to augment their own abilities will be at a distinct advantage compared to professionals who do not use AI (Cardon, Getchell et al., 2023).

## Shifting Priorities for Competencies in the AI Era

At the early stages of the AI Era, experts suggest that the following competencies will increasingly gain importance: integrity, strategic vision, interpersonal skills, innovation and creativity, ability to inspire others, oral communication, adaptability, teamwork, problem-solving, research, and analytics. Most of these competencies are considered human-centered soft skills (Brodnitz, 2024). It is possible that “a renewed focus on soft skills could result in vastly improved workplaces where human connection, strong values, rich communication, and dynamic innovation abound” (Cardon, 2024, Human-Centered Soft Skills, para. 2). Some people suggest that even technical skills will become more aligned with natural ways of communicating. For example, NVIDIA CEO Jensen Huang stated, “It is our job to create computing technology such that nobody has to program. And that the programming language is human. Everybody in the world is now a programmer. This is the miracle of artificial intelligence” (Okemwa, 2024, para. 5).

According to the Microsoft and LinkedIn report (2024), professionals who are adding AI skills to their LinkedIn profiles are typically content writers, graphic designers, marketing managers, front-end developers, entrepreneurs, product designers, operations managers, web developers, account managers, and business development managers. Similarly, among non-technical fields, professionals with the following titles are most likely to add AI skills to their LinkedIn profiles: project managers, product managers, program managers, general managers, architects, graphic designers, account managers, operations managers, marketing managers, accountants, sales managers, and writers (Microsoft & LinkedIn, 2024).

## The AI Era Durable Skills Framework

In the evolving workplace landscape, educators of all disciplines can benefit from a general framework with which to enhance the relevance of their courses. The *AI Era Durable Skills Framework* presented in this chapter draws on two sets of research. Fleischmann et al. (2024) and Cardon, Fleischmann et al. (2023) conducted extensive research among business professionals of varying experience and expertise regarding

shifting competencies in the AI Era, surveying over 700 individuals to identify these competencies using an inventory of durable skills developed by the Graduate Management Admission Council (GMAC) (Estrada-Worthington et al., 2017). Southworth et al. (2023) developed a model of AI literacy for higher education. Their model is based on the efforts of dozens of experts at the University of Florida to create AI curriculum that spans the university. Historically, AI literacy has been a focus of STEM disciplines and fields. The new AI Era, fueled by generative AI, however, expands opportunities for more students to explore and use AI. The University of Florida, in partnership with NVIDIA, aims to build AI pedagogy across the curriculum.

Based on the aforementioned research, a general framework is proposed from which educators can ground their teaching and learning, regardless of discipline. Figure 15.1, drawn from existing research and our own experience, provides a framework for identifying highly valued competencies in the new AI Era. It offers a flexible tool to help students and professionals advance in their careers, particularly as AI becomes integrated into many of today's knowledge work activities. At the core, subject matter expertise and adaptability are competencies that lay a foundation for long-term success. A range of other competency categories position students and employees to thrive in



FIGURE 15.1 The AI Era Durable Skills Framework

AI-enabled workforces, such as technical skills, communication skills, leadership skills, problem solving and creativity, and ethical reasoning.

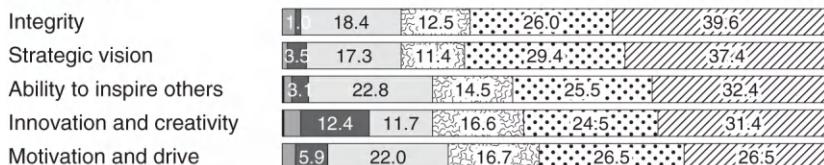
A variety of commentaries have suggested that soft skills will become preeminent in the AI Era (Metz, 2023). While we do not dispute this view, we suggest it is incomplete. There is still a demand for deep expertise and technical knowledge. Subject matter expertise is crucial for several reasons. Although AI can increasingly complete many high-level cognitive tasks, it requires professionals with subject matter expertise to discern the accuracy and value of AI output and identify the degree to which various tasks can be aided through the use of AI (Ali et al., 2024). Subject matter experts are also needed to train AI models for specific purposes and to ensure that AI meets responsible AI standards. Some experts believe that there will even be career opportunities for subject matter experts in history, education, ethics, and many non-technical domains (Galli, 2024).

While subject matter expertise is a core competency in the AI Era, another core competency is adaptability. A LinkedIn analysis of the most in-demand skills for 2024 called adaptability the “top skill of the moment” (Bessalel, 2024, para. 6). Those professionals who will be most sought after will be able to respond quickly and proactively to rapidly evolving technological advancements. Interestingly, one major challenge is that professionals with deep subject matter expertise may find it most difficult to adapt. Thus, it is critical that experts gain the ability to recognize when they need to make small or large pivots in expertise. This process of adaptability is strategic and intellectual, yet also involves emotional resilience.

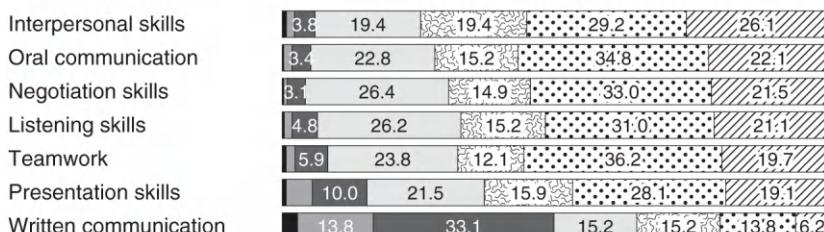
Around the core—*subject matter expertise* and *adaptability*—are five additional competency areas that become more important in the AI Era: communication skills, leadership skills, technical skills, problem solving and creativity, and ethical reasoning. The work of Cardon et al. (2024) helps evaluate the growing importance of these skill sets (see Figure 15.2).

Cardon et al. (2024) found that a majority of current business professionals suggest that communication skills become more important, with anywhere between 63 and 75% agreeing that oral communication, interpersonal skills, negotiation skills, listening skills, teamwork, and presentation skills will become even more important as AI is integrated more deeply into daily workflows. Interestingly,

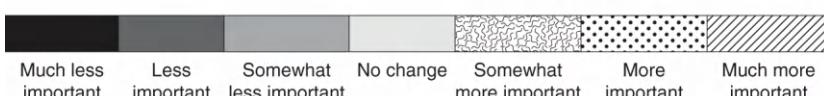
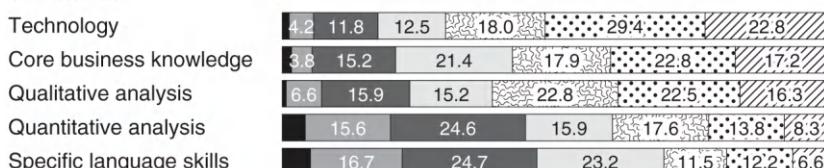
### Leadership



### Communication



### Technical



**FIGURE 15.2** Growing Importance of Various Competencies According to Frequent AI Users (Cardon et al., 2024)

*Note:* The data were drawn from 290 AI power users—business professionals who used AI at least weekly for work. The original scale ranged from 1 (strongly disagree) to 7 (strongly agree), with the numbers indicating percentage responses.

professionals hold mixed views of writing skills. It seems that more highly valued communication skills are those that are interpersonal, verbal, real-time, team-based, and multimodal in nature.

Leadership skills are grouped as integrity, strategic vision, ability to inspire others, innovation and creativity, and motivation and drive. Between 70 and 78% of frequent AI users believe these abilities are

growing in importance. Strategic vision, ability to inspire others, and motivation and drive reflect the importance of leaders and managers who can take the initiative to help their teams grow in the AI Era and who can describe a future that is motivating to employees. The importance of integrity reflects an expectation that leaders and managers align their words and actions with firmly held values. Because integrity is so high, we suggest that ethical reasoning is a skill area that belongs on its own and requires extensive development. Similarly, innovation and creativity belong in their own category as these abilities are human traits that are not as easily mimicked by AI, and which allow professionals to provide unique value in the workplace.

The growth in technical skills is also important to note. The GMAC list of items included technology, core business knowledge, qualitative analysis, quantitative analysis, and language skills. Far fewer frequent AI users identified these as becoming more important, with a range of 30 to 70% suggesting these various skills were growing in significance. Regarding technology skills, while 70% of respondents thought they are growing in importance, we believe the focus should be on AI tools. Southworth et al. (2023) suggest knowledge workers, at minimum, should know and understand machine learning algorithms, how data are used to train LLMs and other AI systems, and the limitations and biases of AI; as well as be able to use and apply a variety of AI tools and platforms, evaluate the quality of AI systems, and discuss and apply AI ethically.

## Adapting Pedagogy: Strategies for Educators in the AI Era

For many years, experts have forecasted AI would automate many work tasks and require professionals to prioritize non-automatable skills (Getchell et al., 2022; Manyika et al., 2017). Yet, until recently, the influence of AI on the everyday work of most white-collar workers has been largely “imperceptible” (Chui et al., 2023, para. 1). Rapid adoption of, and advances in, generative AI have altered that calculus: most white-collar workers believe they need to develop new skills as they integrate AI into their work. In a study of 13,000 employees, 86% reported they needed upskilling due to advances in generative AI,

yet only 14% say they are receiving training (Beauchene et al., 2023). Experts at Harvard's Digital Reskilling Lab estimate that in the age of AI, the half-life of many skills ranges from just two and a half to five years, requiring more constant reskilling (Tamayo et al., 2023).

We believe educators should respond to the current AI moment with urgency. We suggest that AI will increasingly be part of nearly all work and learning activities. Yet, it can easily be overwhelming to teach and train in this fast-moving and quickly evolving environment. Generally, we recommend five key practices:

- 1. Align teaching and learning with competencies that are growing in importance.** Educators across a range of disciplines can use our AI Era Durable Skills Framework (see Figure 15.1). Subject matter expertise, positioned at the core of the framework, still matters, and as such, subject matter experts can teach to their own strengths in their disciplines. While subject matter expertise represents a core competency, the flip side of that is adaptability. As AI is able to accomplish various tasks in any given discipline, professionals will need to make pivots to deepen their knowledge or gain expertise in periphery areas. Therefore, educators should continually explore how AI can enhance efficiencies within their disciplines and assess its impact on determining which topics should take priority in coursework.

Keeping the two core areas in mind (subject matter expertise and adaptability), educators can design assignments and learning activities that help students develop the other five competency areas, which can be developed particularly well through project-based work. Since project-based learning is well established, it is nothing new to propose it again, but its urgency is heightened in the AI Era. As part of coursework, educators can identify creative ways to help students experiment with various AI technologies and reflect on their ethical implications.

- 2. Create a structured approach to involving students in using AI in their learning.** Educators can involve students directly in making decisions about how to use AI in their projects and learning. We encourage educators to use a structured approach to accomplishing this goal. A model of involving students can follow the pattern of Paul Leonardi's (2023) STEP framework, which was developed to involve employees in adapting to increasingly AI-powered work

environments. The four-step STEP framework consists of: (1) segmenting tasks; (2) transitioning tasks; (3) educating employees; and (4) evaluating performance. Segmenting tasks involves identifying whether AI will automate or augment the tasks. Segmenting involves asking three basic questions: which tasks shouldn't AI be involved in; which tasks should AI support or augment; and which tasks should AI automate? Transitioning involves deepening or upgrading roles as AI can automate many tasks that employees would previously do. The focus of education is continual employee reskilling. It prioritizes long-term professional development in an environment in which employees will need to reskill much more rapidly than in the past. The final stage of the STEP framework is performance. It evaluates the ability to engage in the most valued tasks in AI-power environments. We suggest educators can adopt structured approaches to teaching and learning to involve students in adapting coursework to shifting workplace needs.

3. **Experiment daily with AI.** Educators have the opportunity to enhance their proficiency by incorporating AI into their teaching practices. Regardless of their field, they can explore a range of AI tools and platforms, experimenting with their applications to enrich learning experiences. By dedicating 15 to 30 minutes each day to experimenting with AI, educators can stay abreast of AI advancements and gain insights into how their students are likely using AI technologies. This daily experimentation also positions educators to understand how their content adds value to an AI-saturated workplace and how to ensure teaching and learning activities are aligned with the model of growing competencies in the AI Era.
4. **Join communities of practice.** No educator should take their AI journey in isolation. It is recommended they find informal or formal groups of colleagues in their schools, departments, professional societies, or elsewhere to find regular professional development opportunities related to AI. Joining communities of practice comes with many benefits. Educators can benefit from the regular sharing of best practices with members inside and outside their disciplines. They can also benefit emotionally with the camaraderie of peers. AI journeys can be emotional journeys as people need to adapt more rapidly than in the past. Spending time with peers allows educators to cope with these rapid changes. Finally, working in communities of practice helps educators apply the very competencies that are of most importance at this early stage in the new

AI Era, which are supported by the competencies of: subject matter expertise, adaptability, communication skills, leadership skills, technical skills, problem solving and creativity, and ethical reasoning.

5. **Involve AI power users.** There are millions of frequent AI users who are constantly learning new uses of AI and becoming extremely efficient at it. These AI power users possess know-how that is not contained in textbooks and rarely in comprehensive form in online outlets. Educators can benefit from connecting with AI power users within their disciplines to learn about innovative and effective AI applications, thereby informing and enhancing their own teaching methods.

## Summary

This chapter described the characteristics that allow for the AI Era: availability to all knowledge workers, wide adoption by most professionals, rapid increase in AI performance and capabilities, integration to everyday productivity software, and increasing display of humanlike abilities by AI. The *AI Era Durable Skills Framework* was presented to help educators align coursework with student needs in this new era. The framework contains a core of subject-matter expertise and adaptability. Around this core are five categories of skills: technical skills, communication skills, leadership skills, ethical reasoning, and problem solving and creativity. Educators should align their teaching with these competencies, create a structured approach to involving students in using AI in their learning, experiment daily with AI, join communities of practice, and involve AI power users.

## Discussion Questions

1. What are the defining characteristics of the AI Era? How does understanding these characteristics motivate and empower educators to align course content with students' career needs?
2. In your discipline, how can you adapt your teaching to help students develop the right types of subject-matter expertise? How can you help students develop the adaptability to prepare for shifting types of expertise within your discipline?

### 344 Teaching and Learning in the Age of Generative AI

3. In your discipline, how can you help students develop the following competency areas: technical skills, communication skills, leadership skills, ethical reasoning, and problem solving and creativity?
4. In your discipline, explain how you can experiment daily with AI. What types of tasks and activities could you use AI to assist you? How might you take a structured approach to experimenting with AI?
5. What types of communities of practice could you join to enhance your knowledge of AI use in your field?

## References

Ali, R., Connolly, I. D., Tang, O. Y., Mirza, F. N., Johnston, B., Abdulrazeq, H. F., Kim, R. K., Galamaga, P. F., Libby, T. J., Sodha, N. R., Groff, M. W., Gokaslan, Z. L., Telfeian, A. E., Shin, J. H., Asaad, W. F., & Doberstein, C. E. (2024). Bridging the literacy gap for surgical consents: An AI-human expert collaborative approach. *NPJ Digital Medicine*, 7(63). <https://doi.org/10.1038/s41746-024-01039-2>

Anyoha, R. (2017) The history of artificial intelligence. *Science in the News*. <https://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/>

Ayers, J. W., Poliak, A., Dredze, M., Leas, E. C., Zhu, Z., Kelley, J. B., Faix, D. J., Goodman, A. M., Longhurst, C. A., Hogarth, M., & Smith, D. M. (2023). Comparing physician and artificial intelligence chatbot responses to patient questions posted to a public social media forum. *JAMA Internal Medicine*, 183(6), 589–596. <https://doi:10.1001/jamainternmed.2023.1838>

Beauchene, V., de Bellefonds, N., Duranton, S., & Mills, S. (2023, June). AI at work: What people are saying. *BCG*. [www.bcg.com/publications/2023/what-people-are-saying-about-ai-at-work](http://www.bcg.com/publications/2023/what-people-are-saying-about-ai-at-work)

Bessalel, S. (2024, February 8). LinkedIn 2024 most in-demand skills: Learn the skills companies need most. *LinkedIn Learning Blog*. [www.linkedin.com/business/learning/blog/top-skills-and-courses/most-in-demand-skills](http://www.linkedin.com/business/learning/blog/top-skills-and-courses/most-in-demand-skills)

Brodnitz, D. (2024, February). *The most in-demand skills for 2024*. [www.linkedin.com/business/talent/blog/talent-strategy/linkedin-most-in-demand-hard-and-soft-skills](http://www.linkedin.com/business/talent/blog/talent-strategy/linkedin-most-in-demand-hard-and-soft-skills)

Cardon, P. (2024, January 23). New study finds AI makes employers value soft skills more. *Fast Company*. [www.fastcompany.com/91012874/new-study-finds-ai-makes-employers-value-soft-skills-more](http://www.fastcompany.com/91012874/new-study-finds-ai-makes-employers-value-soft-skills-more)

Cardon, P., Fleischmann, C., Logemann, M., Heidewald, J., Aritz, J., & Swartz, S. (2024). Competencies needed by business professionals in the AI

age: Character and communication lead the way. *Business and Professional Communication Quarterly*, 87(2), 223–246. <https://doi.org/10.1177/23294906231208166>

Cardon, P. W., Fleischmann, C., Aritz, J., Logemann, M., & Heidewald, J. (2023). The challenges and opportunities of AI-assisted writing: Developing AI literacy for the AI age. *Business and Professional Communication Quarterly*. <https://doi.org/10.1177/23294906231176517>

Cardon, P. W., Getchell, K., Carradini, S., Fleischmann, C., & Stapp, J. (2023, March 18). Generative AI in the workplace: Employee perspectives of ChatGPT benefits and organizational policies. *SocArXiv*. <https://doi.org/10.31235/osf.io/b3ezy>

ChatGPT. (2023, September 23). *ChatGPT can now see, hear, and speak*. <https://openai.com/index/chatgpt-can-now-see-hear-and-speak/>

Chui, M., Hazan, E., Roberts, R., Singla, A., Smaje, K., Sukharevsky, A., Yee, L., & Zemmel, R. (2023, June). *The economic potential of generative AI: The next productivity frontier*. McKinsey.

Dell'Acqua, F., McFowland, E., III, Mollick, E., Lifshitz-Assaf, H., Kellogg, K. C., Rajendran, S., Krayer, L., Candelon, F., & Lakhani, K. R. (2023). Navigating the jagged technological frontier: Field experimental evidence of the effects of AI on knowledge worker productivity and quality. *Harvard Business School Working Paper 24-013*. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=4573321](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4573321)

Estrada-Worthington, R., Schoenfeld, G., Bastani, M., Bruggeman, P., Williams, T., & Hazenbush, M. (2017). *Corporate recruiters survey report 2017*. Graduate Management Admissions Council.

Fleischmann, C., Logemann, M. K., Heidewald, Cardon, P., Aritz, J., & Swartz, S. (2024). Fostering GenAI literacy in higher education for future workplace preparedness: A mixed-methods study. *ECIS 2024 Proceedings*, 5. [https://aisel.aisnet.org/ecis2024/track13\\_learning\\_teach/track13\\_learning\\_teach/5](https://aisel.aisnet.org/ecis2024/track13_learning_teach/track13_learning_teach/5)

Gawdat, M. (2021). *Scary smart: The future of artificial intelligence and how you can save our world*. Pan Macmillan.

Galli, G. (2024). Peeling back the curtain to unmask the wizard of AI: Considering the collaborative relationship between non-technical subject matter experts and artificial intelligence. *SSRN*. <http://dx.doi.org/10.2139/ssrn.4694869>

Getchell, K., Carradini, S., Cardon, P. W., Aritz, J., Fleischmann, C., Stapp, J., & Ma, H. (2022). Artificial intelligence in business communication: The changing landscape of research and teaching. *Business and Professional Communication Quarterly*. <https://doi.org/10.1177/23294906221074311>

Henshall, W. (2023, August 2). 4 charts that show why AI progress is unlikely to slow down. *Time*. <https://time.com/6300942/ai-progress-charts/>

Leonardi, P. (2023, November–December). Helping employees succeed with generative AI. *Harvard Business Review*. <https://hbr.org/2023/11/helping-employees-succeed-with-generative-ai>

Manyika, J., Lund, S., Chui, M., Bughin, J., Woetzel, J., Batra, P., Ko, R., & Sanghvi, S. (2017, November 28). *Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages*. McKinsey & Company. [www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages](http://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages);

Metz, C. (2023, November 6). Chatbots may “hallucinate” more often than many realize. *The New York Times*. [www.nytimes.com/2023/11/06/technology/chatbots-hallucination-rates.html](https://www.nytimes.com/2023/11/06/technology/chatbots-hallucination-rates.html)

Microsoft & LinkedIn. (2024). *2024 work trend index annual report: AI at work is here. Now comes the hard part*. Authors.

Mollick, E. [@emollick]. (2024, April 11). When someone asks why is AI not changing many things yet, I point to Amara’s Law: “We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run.” [Tweet]. X. <https://x.com/emollick/status/1778542397925806130>

Nerozzi, T. (2023, February 10). Bill Gates says ChatGPT will “change the world,” make jobs more efficient. *Fox Business*. [www.foxbusiness.com/technology/bill-gates-says-chatgpt-will-change-world-make-jobs-more-efficient](https://www.foxbusiness.com/technology/bill-gates-says-chatgpt-will-change-world-make-jobs-more-efficient)

Okemwa, K. (2024, February 28). NVIDIA CEO says the future of coding as a career might already be dead in the water with the imminent prevalence of AI. *Windows Central*. [www.windowscentral.com/software-apps/nvidia-ceo-says-the-future-of-coding-as-a-career-might-already-be-dead](https://www.windowscentral.com/software-apps/nvidia-ceo-says-the-future-of-coding-as-a-career-might-already-be-dead)

Southworth, J., Migliaccio, K., Glover, J., Glover, J., Reed, D., McCarty, C., Brendemuhl, J., & Thomas, A. (2023). Developing a model for AI across the curriculum: Transforming the higher education landscape via innovation in AI literacy. *Computers and Education: Artificial Intelligence*, 4. <https://doi.org/10.1016/j.caeari.2023.100127>

Tamayo, J., Doumi, L., Goel, S., Kovács-Ondrejkovic, O., & Sadun, R. (2023, September–October). Reskilling in the Age of AI. *Harvard Business Review*.

Tyson, J. (2023, May 25). ChatGPT aces CPA exam after prior version flunked. *CFO Dive*. [www.cfodive.com/news/chatgpt-aces-cpa-exam-prior-version-flunked-accounting-audit/651333/#:~:text=ChatGPT%2D4%20recently%20passed%20the,by%20researchers%20at%20four%20universities](https://www.cfodive.com/news/chatgpt-aces-cpa-exam-prior-version-flunked-accounting-audit/651333/#:~:text=ChatGPT%2D4%20recently%20passed%20the,by%20researchers%20at%20four%20universities)

# AI-Driven Self-Directed Lifelong Learning: Personalization and Empowerment in the Digital Age

# 16

*Didem Tufan, Elif Öztürk*

## Introduction

As we advance into the 21st century, artificial intelligence (AI) is playing an increasingly pivotal role in transforming education. The integration of AI technologies offers new opportunities to transform how we approach learning, particularly in the realm of self-directed lifelong learning. This chapter examines how generative AI can enhance our capacity to engage in learning autonomously throughout our lives. It also examines how artificial intelligence can impact self-directed lifelong learning by assisting learners in creating personalized learning pathways, acquiring new skills and knowledge, and adapting to the evolving demands of the workforce.

To fully appreciate AI's potential, it is important to first understand the foundational concepts of self-directed learning and lifelong learning. We will start by defining these key concepts and then explore how AI can significantly support their intersection. By reviewing the current applications, and future possibilities, this chapter aims to provide a comprehensive perspective on how AI can support and advance self-directed

lifelong learning in today's dynamic educational environments. As scholars and self-directed learners ourselves, we wanted to include examples demonstrating how AI can impact self-directed learning endeavors. These scenarios highlight AI's role in supporting lifelong learners in practical, everyday situations.

## The Evolution of Self-Directed Learning

Imagine a university student who, during the pandemic, finds herself navigating a new landscape of remote learning. Initially, she adapts by identifying her goals, seeking out online resources, engaging in virtual study groups, and even starting a blog to reflect on her learning journey. At this stage, she uses basic digital tools and resources to manage her education. However, after the pandemic, with the emergence of more advanced AI systems like ChatGPT, her learning experience becomes even more dynamic and personalized. With the help of an AI-powered learning assistant, she can now carefully select, organize, and manage personalized study materials more efficiently. The AI tool provides real-time feedback on her assignments, suggests new topics to explore based on her progress and tailors recommendations to her specific learning interests. This proactive approach, supported by AI, enhances her self-directed learning, empowering her to take even greater control of her educational journey in ways that were not fully possible before the introduction of these advanced AI technologies.

Self-directed learning is defined as a process in which learners undertake responsibility for controlling their learning objectives and means to meet personal goals or the perceived demands of their individual context (Brookfield, 2009). An important advantage of this process is that learning methods and objectives become highly individualized, tailored to each learner's unique life circumstances and personal interests. This personalization positions the learners themselves as central and integral components of their learning context.

The concept of self-directed learning dates back to the 1960s. In 1969, American psychologist Carl Rogers published the influential book, *Freedom to Learn*. As one of the pioneers of humanistic psychology, Rogers argued that to equip individuals for the challenges of living in

rapidly changing societies, fostering self-directed learning should be a primary goal in formal education settings. Self-directed learning gained importance through influential scholarly works in North America during the 1970s (e.g., Knowles, 1970, 1975; Tough, 1971). American adult educator Malcolm Knowles (1975) initially asserted that self-directed learning is a universal disposition among adult learners, who tend to exhibit an increasing preference towards self-directedness as they mature. Allen Tough was also a key figure in this field, providing a comprehensive description of self-directed learning. He concluded that adults dedicate a significant amount of time to what he termed “learning projects,” aimed at acquiring, maintaining, or altering specific characteristics and skills (1971, p. 250). These learning activities can involve reading, listening, observation, course participation, reflection, exercise, and other methods.

Self-directed learning is a multidimensional concept that should not be approached through one perspective. Morris (2019) summarizes the key foundational opinions of self-directed learning highlighting that the concept is grounded in humanistic philosophy, pragmatic philosophy, and constructivist epistemology, which together represent a process of learning that is individual, purposeful, and developmental. Self-directed learning empowers learners to set their own goals and define what they consider worth learning (Garrison, 1997) and it is closely linked to self-regulated learning, with both terms often used interchangeably in the literature (Abar & Loken, 2010; Francom, 2010; Jossberger et al., 2010). Both self-directed learning and self-regulated learning involve learners taking greater responsibility for their learning.

The benefits of self-directed learning extend beyond formal education, making it a vital component of lifelong learning. Above all, self-directed learning challenges traditional content-centered approaches that position the teacher as the primary source of knowledge and limit the learner’s active participation in shaping their own educational experience. By mastering self-directed learning, adults are better equipped to navigate the Information Age, where rapid technological developments significantly impact professional lives. Moreover, self-directed learning is recognized for enhancing both short-term and long-term learning outcomes and is regarded as an essential skill for fostering lifelong learning (Sze-Yeng & Hussain, 2010).

## The Synergy of Self-Directed and Lifelong Learning

Lifelong learning has become increasingly relevant due to continuous social, technological, and economic changes. As a result, it can serve as a strategy for maintaining competitiveness, necessitating a flexible and dynamic educational approach that extends beyond formal schooling or degree attainment. London (1996) asserts that it is impractical for traditional educational institutions alone to provide learners with all the knowledge and skills required for sustained success throughout their lives. Hence, individuals need to continually enrich their knowledge and skills in order to address immediate learning needs and to be a part of a process of ongoing vocational and professional development.

The synergy between self-directed learning and lifelong learning is evident in the way each supports and enhances the other. In fact, lifelong learning requires a commitment to ongoing education, which is inherently self-directed. By fostering self-directed learning skills, individuals become adept at managing their own learning processes, making lifelong education a sustainable and effective practice (Bolhuis, 1996). This relationship ensures that learners remain motivated and capable of pursuing knowledge throughout their lives, adapting to new challenges and opportunities with confidence and competence.

When considering self-directed lifelong learning for teachers, practical applications become evident. For instance, imagine a high school teacher who excels in traditional face-to-face instruction but must transition to online teaching. Confronted with the challenge of maintaining student engagement in a virtual setting, she recognizes the need to adapt. Embracing self-directed lifelong learning, the teacher enrolls in online courses focused on digital learning tools and instructional strategies, explores various educational platforms, and joins professional communities for support and collaboration. She develops skills to create interactive online lessons, utilizes collaboration tools effectively, and provides meaningful feedback through digital channels. Despite initial challenges, her commitment to acquiring new competencies enables her to deliver engaging and effective online instruction, ensuring that her students continue to receive high-quality education.

This example highlights how self-directed lifelong learning empowers educators to navigate and overcome new challenges. In today's rapidly evolving educational landscape, such continuous learning is important

for teachers to remain effective and resilient, demonstrating the critical importance of adopting innovative methods and technologies. According to Hager (2011), self-directed learning is fundamental to lifelong education, as it empowers learners to continually adapt and thrive.

The proliferation of web technologies, online learning platforms, and other informal learning methods has significantly expanded the availability of educational resources and opportunities. This development enables individuals to more easily create personalized learning experiences (Lai & Gu, 2011; Reinders & White, 2011).

## The Role of AI in Supporting Self-Directed Lifelong Learning

The proliferation of web technologies, online learning platforms, and other informal learning methods has significantly expanded the availability of educational resources and opportunities. This section examines how AI transforms self-directed learning by providing advanced tools and resources that empower learners to manage their educational pathways.

Self-directed learning entails proactively determining what, when, and how to learn, a process greatly enhanced by technology that offers access to diverse courses, videos, and lessons aligned with individual goals. AI further augments this by analyzing learning patterns, recommending tailored content, and delivering real-time feedback, thereby increasing the effectiveness of self-directed learning. Additionally, AI-driven platforms support continuous education by adapting to personal needs and keeping pace with technological advancements (Li et al., 2024).

In a very near future, AI will offer even more precise and effective personalization, potentially creating personalized learning experiences for individuals based on their unique learning preferences and goals. According to Li et al. (2024), as the concept of lifelong learning becomes increasingly important, AI will play a critical role in supporting self-directed learning across different stages of life. This includes continuous skill development and upskilling in response to the rapidly changing job market in every field including education. By using AI,

learners can now take full control of their education, discovering new content, assessing their progress, and adjusting their learning pathways in real time (Tapalova & Zhiyenbayeva, 2022).

One way AI can transform how people approach learning is by acting as a personalized tutor, resource creator, and motivator. Through intelligent algorithms, AI can help learners discover relevant materials, suggest next steps, and track their progress. Unlike traditional learning environments characterized by static and uniform content, artificial intelligence technologies enable the creation of personalized and adaptive learning experiences for self-directed learners (Shamsuddinova et al., 2024). For instance, a learner who has completed a beginner course in Python on an AI-powered platform may receive recommendations for more advanced topics, such as machine learning or data structures, based on their prior progress. Additionally, the AI can also suggest complementary resources including videos, interactive coding exercises, and relevant reading materials aligned with the individual's learning preferences.

### *AI-Driven Personalized Learning*

AI's ability to create personalized learning paths is one of its most powerful features. Unlike traditional systems that apply a one-size-fits-all approach, AI uses data from user interactions to continuously refine the learning experience. It tracks which topics learners are very good at and where they need more help, dynamically adjusting the content to suit their evolving needs. This approach is analogous to a teacher's use of scaffolding within Vygotsky's Zone of Proximal Development, where, as Vygotsky (1978) posited, providing appropriate support at the right time can significantly enhance students' learning. A number of AI-driven platforms are already shaping how individuals find and consume learning resources.

For instance, AI-driven recommendation systems in platforms like Coursera, edX, Udemy, or Khan Academy are valuable for self-directed learners. These systems suggest courses and resources based on a learner's past activity and interests, helping them further their knowledge and expertise (Habil et al., 2023). Imagine an educational researcher who has just completed a course on educational

psychology through Coursera, gaining insights into cognitive development, learning theories, and classroom practices. As she finishes the course, Coursera's AI-powered system recommends additional courses aligned with her interests and goals. For example, it suggests a course on instructional design, which would help her apply the principles of educational psychology to create and evaluate effective learning materials. The AI also recommends a course on assessment and evaluation techniques to strengthen her skills in developing assessments and using data to improve educational practices. If she is interested in integrating technology into her research, the AI proposes a course on educational technology, focusing on digital tools and platforms in education. By analyzing her learning history, the AI system offers personalized recommendations that support her professional growth and deepen her expertise.

In his book *Co-Intelligence: Living and Working with AI* (2024), Mollick dedicates an entire chapter to *AI as tutor*, emphasizing the potential of large language model technologies as highly efficient and powerful tutoring platforms. He highlights that the dynamic interaction between a tutor and a student has a unique and powerful impact that is hard to replicate through other means. It's no surprise, then, that a personalized tutor—one that is efficient, adaptable, and cost-effective—is often seen as the ultimate goal in education. Mollick perceives this as the primary domain where AI can play a transformative role. Supporting his view, Sal Khan (2023) addressed the *Two Sigma Problem*, based on Benjamin Bloom's 1984 study, which demonstrated that one-to-one tutoring could lead to significant improvements in student performance but has been impractical due to cost and scalability. Khan's solution, Khanmigo, provides personalized support for math and programming exercises, offering context-sensitive help for video content (Khan Academy, n.d.). It also collaborates on tasks like story writing and offers feedback to enhance writing skills. We believe that similar virtual assistants will become increasingly common in self-directed learning environments.

YouTube's algorithm, originally designed for entertainment, also serves as a powerful resource for finding educational videos. By analyzing a user's viewing history, search queries, and engagement with content, YouTube's AI can suggest videos that align with the learner's current interests and knowledge goals (Mage, 2022). For example, imagine someone who frequently watches videos on basic gardening

techniques, plant care, and seasonal planting tips. As this interest deepens, YouTube's AI steps in, recognizing the viewer's preferences and tailoring recommendations accordingly. What starts with beginner-friendly content soon expands, as the AI suggests more advanced topics like soil management or pest control. Noticing an affinity for practical advice, the AI also begins recommending do-it-yourself (DIY) garden projects that align with the learner's interests. As the viewing habits evolve, the AI gets even more specific, offering seasonal gardening advice to match the time of year. Beyond that, it might suggest inspiring success stories from other home gardeners, providing motivation and new ideas. This personalized curation turns the learning experience into a dynamic, self-directed journey, where the learner continuously discovers new techniques and perspectives in gardening.

Another example of an AI-powered tool for discovering content is Feedly, which consolidates updates from websites, blogs, and news outlets into one platform, helping users stay informed without needing to visit multiple sites (McCorkle & Alexander, 2019). For example, a self-directed learner interested in sustainable living might use Feedly ([www.feedly.com](http://www.feedly.com)) to follow various sources related to eco-friendly practices, green technologies, and environmental science. Suppose the learner regularly reads articles about sustainable agriculture and zero-waste lifestyle tips. Feedly's AI analyzes her reading habits and begins to recommend additional content such as blog posts on urban farming techniques, news on new sustainable products, or articles on reducing plastic use. This personalized content feed ensures that the learner stays informed about the latest trends and research related to her interests, supporting her ongoing education and practical application of sustainable living practices.

In today's fast-paced academic world, self-directed learners rely on tools like Google Scholar (<https://scholar.google.com>) and ResearchGate ([www.researchgate.net](http://www.researchgate.net)) to navigate the overwhelming flow of information. Google Scholar uses AI to recommend research papers and articles tailored to individual search queries and reading history, making it easier to uncover relevant resources. ResearchGate enhances this experience by not only suggesting academic papers but also fostering connections with others in the field, offering discussions and collaborative opportunities based on a learner's research activity. Together, these platforms empower learners to efficiently discover content and build meaningful academic networks.

### *AI in Interactive and Engaging Learning Tools*

AI-powered tools have also significantly transformed how self-directed learners interact with content, making the learning process more engaging, personalized, and effective. By incorporating AI, these tools offer dynamic and adaptive experiences that go along with individual learning needs and preferences. In this section, we explore how four prominent AI-driven platforms, Duolingo, Brilliant.org, Kahoot!, and ChatGPT, contribute to self-directed learning and enhance the overall learning experience.

Duolingo uses AI to deliver a gamified language learning experience, creating engaging and interactive exercises that adapt to the learner's proficiency level (n.d.). This adaptive learning approach ensures that learners are challenged appropriately and receive feedback tailored to their progress. For example, a self-directed language learner studying Spanish might use Duolingo to improve his language skills. As he progresses through the lessons, Duolingo's AI tracks his performance on gamified exercises, like vocabulary challenges and grammar quizzes. If the learner struggles with specific concepts, the AI adjusts the difficulty of future exercises and introduces targeted practice to reinforce those areas. This personalized approach helps learners stay motivated and continuously improve their language abilities (Hidayati & Diana, 2019).

Brilliant.org makes learning fun and engaging by offering interactive problem-solving challenges and courses, with AI providing instant feedback and personalized hints (n.d.). A self-directed learner diving into advanced math on the platform gets real-time support; when she struggles with a tough problem, Brilliant's AI steps in with tailored hints and step-by-step guidance. It might even suggest extra practice problems to help reinforce tricky concepts. This hands-on, adaptive approach makes mastering complex topics not only effective but enjoyable, transforming learning into a dynamic experience.

Kahoot! uses AI to create interactive quizzes and games that enhance learner engagement through real-time competition and feedback (n.d.). Self-directed learners can access Kahoot's vast library of quizzes to test themselves on a wide range of topics. They can search for specific topics and take quizzes independently, which can be particularly helpful for reinforcing knowledge or practicing skills

in an engaging way. The AI in Kahoot! generates questions based on their chosen topics and tracks their performance over time. Similarly, learners can use the built-in AI tools in Kahoot! to generate quizzes from any PDF document. The AI creates questions based on the selected content and tracks the learner's performance over time, providing insights into their progress, as well as how they rank compared to other participants. This dynamic learning environment encourages continued engagement and helps learners identify areas where they may need additional study.

Finally, and most prominently, ChatGPT and other AI-powered chatbots based on advanced large language models, offer immediate, context-relevant explanations and resources, making them valuable tools for research and exploration of new subjects. Imagine a teacher preparing for the new school year. She wants to improve her use of formative assessments, so she asks ChatGPT for help. It quickly explains the basics, offering examples like exit tickets and peer reviews, and why they matter for student feedback. Intrigued, she asks how to adapt these methods for her online classroom, and ChatGPT gives practical tips tailored to her needs. Inspired, she dives deeper, exploring articles and resources it recommends to sharpen her skills further. These tools help learners stay motivated, receive timely feedback, and access relevant content, supporting their continued growth and exploration in various subjects (Abas et al., 2023).

### *AI in Goal Setting and Progress Tracking*

AI-powered tools like Trello, Habitica, and Focuster are increasingly helping self-directed learners manage their goals and productivity. These tools use AI to offer insights, motivate users, and help them stay on track.

Trello uses a visual system to help users manage tasks, processes, and projects, with customization options like file attachments, checklists, and automation to fit their needs (n.d.). The AI-powered Lens app assists users in analyzing their Trello boards, uncovering useful insights and hidden trends, enabling them to streamline workflows, make informed decisions, and achieve success with their projects. Focuster helps users prioritize tasks and manage time effectively by integrating with calendars and providing real-time adjustments (n.d.). Habitica

takes goal setting to the next level by using AI to gamify the process, turning daily tasks and long-term goals into a role-playing game. Users earn rewards and level up for completing tasks and staying productive, which helps keep them motivated (Habitica, n.d.).

Imagine a self-directed learner juggling multiple goals such as completing a certification course, improving her language skills, and contributing to a community project. She adds each goal to Habitica, turning them into daily quests. Every time she finishes a module in her course or practices her language skills, she earns points and levels up her character, unlocking rewards like virtual gear or in-game pets. The more productive she is, the more her character grows, making learning feel like an adventure.

AI-powered tools like Trello, Habitica, and Focuster can help self-directed learners stay organized, motivated, and on track by offering task management, real-time adjustments, and gamified goal setting.

## Summary

AI is playing an increasingly significant role in self-directed lifelong learning. Throughout this chapter, we have explored how AI technologies are reshaping the learning experience with personalized pathways, real-time feedback, content recommendations, and interactive tools that enhance learning autonomy. AI is fundamentally altering how learners engage with content, tracking their progress, and expanding their knowledge horizons. In this swiftly developing era, AI's potential in self-directed lifelong learning will likely continue to grow. Current AI tools already enable learners to navigate various information more effectively, helping them filter content based on their personal learning needs, interests, and goals. With AI's assistance, learners can also track their progress, set new goals, and find learning materials that challenge their current understanding and promote deeper exploration.

Moreover, AI will likely continue to evolve, incorporating even more sophisticated features, such as AI-driven personal learning assistants that are capable of identifying learning gaps, setting goals, and offering real-time adjustments based on a learner's progress. These future developments hold exciting possibilities for learners, offering even more personalized support and insight into how they can improve and expand their knowledge. Learners should stay updated on emerging

AI technologies and platforms to benefit from these advancements in their lifelong learning efforts.

The benefits of integrating AI technologies for personalized learning, however, need to be juxtaposed against the inherent risks associated with privacy, informed consent, data protection, bias, and fairness. As these systems become more complex, learners should also be mindful of their privacy and data security, ensuring that their personal learning data is used ethically and transparently (West, 2019). This includes understanding the inherent biases that may exist within AI-driven systems. For example, AI recommendations are only as unbiased as the data they are trained on, meaning that learners should be cautious of any AI tool that may present a narrow or culturally skewed set of learning resources (Binns, 2018). Learners are encouraged to actively seek out diverse perspectives, ensuring that their self-directed learning is inclusive and well-rounded (Mhlanga, 2023).

In summary, AI's role in self-directed lifelong learning is vast and transformative, offering learners highly customized and engaging ways to achieve their educational goals. However, as Mollick (2024) notes, because AI is a general-purpose technology, there isn't a single guide or instruction manual that can fully explain its potential and limitations. As AI continues to evolve, its integration into lifelong learning needs to strike a careful balance, respecting the independence of learners while ensuring that the tools and systems remain inclusive, transparent, and equitable. By staying aware of both the possibilities and challenges presented by AI, learners can continue to succeed in their self-directed learning paths, growing and adapting as technology advances.

## Discussion Questions

1. How can AI tools be integrated into existing lifelong learning frameworks to enhance their effectiveness?
2. What are the potential challenges of incorporating AI into self-directed learning environments, and how can they be addressed?
3. How can educators balance the use of AI with the need for human interaction and mentorship in lifelong learning?

4. Develop a proposal for integrating AI into a specific lifelong learning program. What objectives would you aim to achieve, and how would you measure success?
5. Reflect on the role of AI in shaping future workforce skills. How can learners and educators prepare for these changes?

## References

Abar, B., & Loken, E. (2010). Self-regulated learning and self-directed study in a pre-college sample. *Learning and Individual Differences*, 20(1), 25–29. <https://doi.org/10.1016/j.lindif.2009.10.002>

Abas, M. A., Arumugam, S. E., Yunus, M. M., & Rafiq, K. R. M. (2023). ChatGPT and personalized learning: Opportunities and challenges in higher education. *International Journal of Academic Research in Business and Social Sciences*, 13(12), 3936–3945.

Binns, R. (2018). Fairness in machine learning: Lessons from political philosophy. In *Conference on Fairness, Accountability and Transparency* (pp. 149–159). PMLR. <https://proceedings.mlr.press/v81/binns18a.html>

Bloom, B. S. (1984). The 2 sigma problem: The search for methods of group instruction as effective as one-to-one tutoring. *Educational researcher*, 13(6), 4–16.

Bolhuis, S. (1996). Towards active and self-directed learning: Preparing for lifelong learning, with reference to Dutch secondary education. *European Journal of Education*, 31(4), 427–440. <https://doi.org/10.2307/1503344>

Brilliant.org. (n.d.). Brilliant: Learn math and science. [www.brilliant.org](http://www.brilliant.org)

Brookfield, S. D. (2009). Self-directed learning. In R. Maclean & D. Wilson (Eds.), *International handbook of education for the changing world of work*. Springer Science Business Media. [https://doi.org/10.1007/978-1-4020-5281-1\\_7](https://doi.org/10.1007/978-1-4020-5281-1_7)

Duolingo. (n.d.). Learn languages for free. [www.duolingo.com](http://www.duolingo.com)

edX. (n.d.). Free online courses from top universities. [www.edx.org](http://www.edx.org)

Focuster. (n.d.). Time management software. [www.focuster.com](http://www.focuster.com)

Francom, G. M. (2010). Teach me how to learn: Principles for fostering students' self-directed learning skills. *International Journal of Self-Directed Learning*, 7(1), 29–44.

Garrison, D. R. (1997). Self-directed learning: Toward a comprehensive model. *Adult Education Quarterly*, 48(1), 18–33. <https://doi.org/10.1177/074171369704800103>

Habil, S., El-Deeb, S., & El-Bassiouny, N. (2023). AI-based recommendation systems: The ultimate solution for market prediction and targeting. In C. L. Wang (Ed.), *The Palgrave handbook of interactive marketing* (pp. 683–704). Springer International Publishing.

Habitica. (n.d.). *Habitica: Gamify your life*. [www.habitica.com](http://www.habitica.com)

Hager, P. J. (2011). Concepts and definitions of lifelong learning. In M. London (Ed.), *The Oxford handbook of lifelong learning* (pp. 12–25). Oxford University Press.

Hidayati, T., & Diana, S. (2019). Students' motivation to learn English using mobile applications: The case of Duolingo and Hello English. *JEELS (Journal of English Education and Linguistics Studies)*, 6(2), 189–213.

Jossberger, H., Brand-Gruwel, S., Boshuizen, H., & Van De Wiel, M. (2010). The challenge of self-directed and self-regulated learning in vocational education: A theoretical analysis and synthesis of requirements. *Journal of Vocational Education & Training*, 62(4), 415–440. <https://doi.org/10.1080/13636820.2010.523479>

Kahoot! (n.d.). *Kahoot! Play and create quizzes*. [wwwkahoot.com](http://wwwkahoot.com)

Khan, S. (2023). Sal Khan's 2023 TED Talk: AI in the classroom can transform education. *Khan Academy Blog*. <https://blog.khanacademy.org/sal-khans-2023-ted-talk-ai-in-the-classroom-can-transform-education>

Khan Academy. (n.d.). *Khanmigo*. [www.khanmigo.ai](http://www.khanmigo.ai) [www.khanmigo.ai](http://www.khanmigo.ai)

Knowles, M. (1970). *The modern practice of adult education: Andragogy versus pedagogy*. Association Press.

Knowles, M. (1975). *Self-directed learning: A guide for learners and teachers*. Follett Publishing Company.

Lai, C., & Gu, M. Y. (2011). Self-regulated out-of-class language learning with technology. *Computer-Assisted Language Learning*, 24(4), 317–335. <https://doi.org/10.1080/09588221.2011.568417>

Li, B., Bonk, C. J., Wang, C., & Kou, X. (2024). Reconceptualizing self-directed learning in the era of generative AI: An exploratory analysis of language learning. *IEEE Transactions on Learning Technologies*. <https://doi.org/10.1109/TLT.2023.1234567>

London, M. (1996). Redeployment and continuous learning in the 21st century: Hard lessons and positive examples from the downsizing era. *Academy of Management Perspectives*, 10(4), 67–79. <https://doi.org/10.5465/AME.1996.9704031271>

Mage. (2022). *YouTube's machine learning algorithm*. [www.linkedin.com/pulse/youtubes-machine-learning-ml-algorithm-magetech](http://www.linkedin.com/pulse/youtubes-machine-learning-ml-algorithm-magetech)

McCorkle, D., & Alexander, J. F. (2019). Using a digital personal learning network assignment to teach social curation and lifelong learning in marketing. *Journal of Advertising Education*, 23(2), 108–120.

Mhlanga, D. (2023). Open AI in education, the responsible and ethical use of ChatGPT towards lifelong learning. In *FinTech and artificial intelligence for sustainable development: The role of smart technologies in achieving development goals* (pp. 387–409). Springer Nature Switzerland.

Mollick, E. (2024). *Co-intelligence: Living and working with AI*. Ebury Publishing.

Morris, T. H. (2019). Self-directed learning: A fundamental competence in a rapidly changing world. *International Review of Education*, 65(4), 633–653. <https://doi.org/10.1007/s11159-019-09793-2>

Reinders, H., & White, C. (2011). Learner autonomy and new learning environments. *Language Learning & Technology*, 15(1), 1–3.

Rogers, C. R. (1969). *Freedom to learn*. Charles Merrill.

Shamsuddinova, S., Heryani, P., & Naval, M. A. (2024). Evolution to revolution: Critical exploration of educators' perceptions of the impact of artificial intelligence (AI) on the teaching and learning process in the GCC region. *International Journal of Educational Research*, 125, 102326.

Sze-Yeng, F., & Hussain, R. M. R. (2010). Self-directed learning in a socioconstructivist learning environment. *Procedia-Social and Behavioral Sciences*, 9, 1913–1917.

Tapalova, O., & Zhiyenbayeva, N. (2022). Artificial intelligence in education: AIED for personalised learning pathways. *Electronic Journal of e-Learning*, 20(5), 639–653.

Tough, A. M. (1971). *The adults' learning projects: A fresh approach to theory and practice in adult education*. The Ontario Institute for Studies in Education. <http://ieti.org/tough/books/alp.htm>

Trello. (n.d.). *Organize anything with anyone, anywhere!* [www.trello.com](http://www.trello.com)

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*, 86. Harvard University Press.

West, S. M. (2019). Data capitalism: Redefining the logics of surveillance and privacy. *Business & Society*, 58(1), 20–41.

# The Future of Learning: 17 AI-Driven Education in 2040

*Joseph Rene Corbeil*

## Introduction

As we approach the year 2040, education is poised for a monumental transformation, largely driven by the rapid advancements in artificial intelligence (AI) and related technologies. This chapter offers a forward-looking exploration of how these technological advancements will reshape the educational experience for students, educators, and institutions alike. Through the imaginative use of design fiction, the chapter presents day-in-the-life scenarios that vividly illustrate the integration of AI into the educational routine, highlighting the profound implications for teaching, learning, and student engagement.

A central theme of future education is the development of “phygital” learning environments, which seamlessly integrate physical and digital spaces to redefine traditional classrooms. By 2040, these environments will transcend the limitations of four walls, utilizing augmented reality (AR) and virtual reality (VR) to craft immersive, interactive, and inclusive learning experiences. AI will further enhance these technologies by providing real-time adjustments to learning content, tailoring experiences to individual student needs, and fostering greater engagement. For example, AI could dynamically modify VR scenarios based on student interactions or suggest AR overlays that align with a learner’s specific interests, making education more personalized and effective than ever before.

AI-powered personalized learning will be fundamental, as algorithms analyze individual student data to customize instruction to each learner's needs, preferences, and pace. This will allow students to approach topics based on their strengths and interests. Intelligent tutoring systems (ITS) will provide real-time feedback and adapt to student performance, enabling educators to focus on mentoring and inspiring students. Adaptive learning platforms will cater to diverse needs such as disabilities and language differences, ensuring equitable opportunities for all learners. The integration of VR and AR within these platforms will create immersive experiences that overcome physical limitations, enabling full participation for students who may have previously faced barriers in traditional educational settings.

By exploring the potential of emerging and future AI-driven technologies, personalized learning, ITS, and adaptive learning platforms, the chapter envisions a future where education is dynamic, inclusive, and tailored to the unique needs of every learner. As we move towards this AI-driven educational landscape, the possibilities for enhancing teaching and learning are boundless, promising a future where everyone has the opportunity to thrive in a rapidly changing world.

## Education in the Year 2040: A Day in the Life

The soft chime of Eve, the AI assistant, gently nudged Professor Sarah Chen awake. It was 6:30 am, and as she opened her eyes, Eve's soothing voice reminded her of the day's schedule. "Good morning, Professor Chen. It's time to rise and shine."

At the same moment, across town, Alex Rodriguez's wearable AI assistant gently vibrated, waking him up at the optimal point in his sleep cycle. "Good morning, Alex," the AI said softly, "it's time to start your day."

By 7:00 am, Sarah was seated at her kitchen table, savoring the aroma of freshly brewed coffee. As she sipped her drink, she reviewed personalized reports generated by Eve. Each student's progress, strengths, and areas needing attention were highlighted with meticulous detail, allowing her to tailor her teaching approach for the day.

Meanwhile, Alex was at his breakfast table, reviewing his personalized learning schedule on his AR glasses. The schedule, tailored by his

AI, balanced his academic needs with his personal interests. Today promised to be particularly engaging, with a blend of VR sessions, in-person discussions, and collaborative projects.

At 8:30 am, Sarah arrived at the hybrid learning center, a state-of-the-art facility seamlessly blending physical and virtual learning environments. Her first task was a virtual meeting with her global teaching team. The holographic interface brought her colleagues from various time zones into the same digital room, where they discussed curriculum updates and shared innovative teaching strategies.

Simultaneously, Alex began his day with a VR language immersion session. The virtual Beijing market came alive around him as he practiced Mandarin with AI-powered characters. The experience felt incredibly lifelike—through the haptic sensors in his shoes he could feel the texture of the cobblestone streets and the subtle vibrations of a vendor's cart as it rolled by, while the realistic sounds of bustling conversations filled the air.

By 10:00 am, Alex joined Sarah's in-person discussion group on the ethical implications of recent scientific discoveries. As Alex took his seat, Sarah greeted the students, her presence warm and welcoming. The AI moderator, integrated into the classroom system, provided real-time fact-checking and suggested discussion points, ensuring a rich and engaging debate.

Alex actively participated in the discussion, his AI assistant taking notes and suggesting relevant questions. The lively exchange of ideas invigorated him, and he appreciated the real-time insights provided by his AI.

At 11:30 am, Alex engaged in a collaborative problem-solving session with peers from around the world, working on a project to design sustainable urban transportation systems. The digital collaboration space allowed them to share ideas and models in real-time, breaking down geographical barriers.

During this time, Sarah moved to the VR lab, where students were immersed in historical simulations. She walked among them, offering guidance and context to the virtual scenes of ancient civilizations.

After a quick lunch, Sarah met with Alex for a one-on-one mentoring session at 1:00 pm. Alex had been struggling with complex problem-solving, and Sarah used AI-generated insights to tailor her approach, breaking down the problems into manageable steps and offering personalized feedback.

Following their session, Sarah collaborated with the AI curriculum designer at 2:30 pm. Together, they brainstormed new ways to teach sustainability, blending elements of science, technology, and social studies into cohesive project-based learning modules.

By 4:00 pm, Sarah was recording a short holographic lecture for her global student base. The AI ensured her lecture would be translated into multiple languages, making her teachings accessible to students around the world. As the day wound down, she felt a deep sense of fulfillment, knowing she had touched minds far beyond the confines of her classroom.

Meanwhile, Alex's formal learning day ended at 5:00 pm with him updating his digital portfolio with new projects and reflections. The AI helped organize and tag his work, making it easy to track his progress and set future learning goals.

## Designing the Future Through Design Fiction

This story of a day in the life of Sarah and Alex, set in the year 2040, illustrates how artificial intelligence and advanced technologies could seamlessly integrate into every aspect of daily life, providing a compelling vision of the future of work, education, and everyday living. Though a work of *design fiction*, this story used *prototypes* of existing and emerging technologies to explore and envision future possibilities.

Coined by Bruce Sterling in his 2005 book *Shaping Things*, design fiction is “the deliberate use of diegetic prototypes to suspend disbelief about change” (Sterling, 2013, para. 2). “[T]he embedding of diegetic prototypes within narratives,” as explained by Kirby (2010), “contextualizes emergent technologies within the social sphere” (p. 44). In other words, diegetic prototypes—fictional objects or systems embedded within a narrative—enhance the realism of the imaginary world, enabling audiences to envision their impact on daily life. According to Sterling, writers often use design fiction intentionally to create immersive prototypes to help their readers imagine different worlds, while adhering to ethical guidelines.

In an article titled, “A leap into the unknown: How ‘design fiction’ is shaping our future,” Jamie Graham (2020) discusses how companies like Tesla, Google, Disney, Microsoft and Apple, among others, are employing design fiction to drive innovation by imagining

future scenarios and integrating speculative elements into their R&D processes. By employing science fiction writers and futurologists, businesses are creating hypothetical prototypes and narratives to explore potential technologies and their impacts, thereby preparing for future challenges and opportunities.

As we explore the future landscape of teaching and learning in 2040, we will employ design fiction to imagine how emerging AI and other technologies are set to revolutionize education, creating more automated, dynamic, immersive, and hyper-personalized learning environments, while preserving the essential human touch between teachers and their learners.

In this chapter, we will examine the future trajectories of new and emerging technologies powered by artificial intelligence as well as their potential impacts. We will envision how these technologies may transform work, education, and everyday life, and explore the possibilities for teaching and learning in an AI-driven world in the year 2040.

## The Future Will Converge on the “Phygital”

The future of education is set to converge more profoundly on the physical aspects, enhanced by digital technology, to create a truly *phygital* learning environment. Coined by Chris Weil, Chairman-CEO of Momentum Worldwide, in 2007, the term phygital underscores the seamless integration of our physical world with the digital spaces we interact with (The Business Paradox, 2023). As students and educators increasingly navigate fluidly between online and offline worlds, the integration of physical and digital elements in education will become seamless and holistic (Maxicus, n.d.). This convergence will leverage advanced technologies like AI and AR to bring virtual objects into the real world, offering students immersive, engaging, and realistic learning experiences (Kumar, 2023). By 2040, classrooms will be equipped with AR devices that allow students to interact with virtual models in a tangible way, fostering a deeper understanding of complex concepts. According to Kumar (2023), AI will further personalize these experiences, adapting content to individual learning style preferences and paces. The goal is not only to enhance the physical and virtual classroom experiences, but also to ensure that education remains

relevant to the real-world applications, preparing students for future careers (edCircuit, 2023). While challenges such as the digital divide persist, the phygital approach holds the promise of making education more inclusive, interactive, and effective by merging the best of both the physical and digital worlds (Kumar, 2023).

By 2040, a host of wearable smart devices are expected to be highly advanced, integrating seamlessly into daily life and offering a range of functionalities beyond what is available today. Here are some key predictions based on current trends and technological advancements:

- **Smartphones.** In 2040, smartphones and handheld devices may undergo significant transformations, becoming more flexible or foldable, allowing them to morph between different form factors as needed (Rutnik, 2022). According to Rutnik, these devices could feature transparent or holographic displays capable of projecting 3D images, providing a more immersive visual experience. Seamless integration with AR technologies is also expected, blending digital information effortlessly with the physical world. Advanced AI is anticipated to play a significantly larger role as well, transforming phones into highly capable personal assistants. This advancement will enable more intuitive and predictive interactions, thereby enhancing user engagement (Eadicicco, 2024). Your smartphone will feature advanced visual recognition technology, allowing you to instantly access information about objects, people, landmarks, and scenes by simply pointing the camera. The integrated AI assistant will not only handle making calls for you but also offer financial advice tailored to your spending habits, interests, and income (Zarkov, 2018). Despite these advancements, some argue that traditional smartphones could be replaced entirely by wearable technologies, further revolutionizing the way we interact with digital information (Hughes, 2023). Imagine a future where wearable devices like the *Humane AI pin* replace smartphones. These user-friendly, voice-activated gadgets can make calls, send messages, find information, capture moments, take notes, and manage your digital life, acting as your assistant and second brain (Humane, n.d.).
- **Smart Jewelry.** Wearable technologies are becoming less visible and more integrated into everyday accessories like jewelry. Smart rings, for example, represent a significant advancement in this field, offering a blend of style, convenience, and advanced

functionality. Initially developed as a discreet alternative to bulky smartwatches and fitness trackers, these rings now come equipped with sensors to track health metrics, monitor sleep, and facilitate contactless payments (Lee, 2024). The integration of Bluetooth enables smart rings to sync with smartphones, providing notifications and controlling smart home devices, thereby enhancing the user experience through seamless connectivity. Future AI-powered smart rings will incorporate advanced functionalities that go beyond health tracking, sleep monitoring, and contactless payments. These rings will leverage AI to offer personalized health insights, predict potential health issues, and suggest proactive measures. Smart bracelets with built-in safety features such as GPS, accelerometers, and NFC capabilities will also be common. They will provide continuous data on vital signs, glucose levels, and other health metrics, which will aid in early detection of diseases and personalized health management. NFC technology will facilitate contactless payments through simple hand gestures. (Encata Engineering Catalyst, 2023). A prototype bracelet currently being developed at the University of Alabama at Birmingham will use machine learning and sensors to detect physical assaults. When danger is detected, the bracelet emits a loud beeping sound and flashes red strobe lights to deter attackers and alert bystanders. Connected to the user's smartphone via Bluetooth, it can send emergency messages and the user's location to emergency contacts and authorities. Next-generation AI-enhanced smart bracelets will monitor vital signs, detect falls, and determine the orientation of the user, for example, whether they are standing or lying down, providing valuable safety features for the elderly and individuals with disabilities (American College of Sports Medicine, 2023). Based on current trajectories, by 2040, AI-driven smart jewelry will revolutionize daily life, offering seamless solutions for health monitoring, shopping, safety, and effortless integration with the evolving Internet of Things (IoT).

- **Smart Clothing.** By 2040, smart clothing will also become more prevalent, incorporating sensors and electronics to monitor health metrics, adjust to environmental conditions, and even charge other devices. Examples include intelligent swimsuits with UV sensors and clothing that can regulate temperature (Marr, 2020). Smart fabrics will incorporate technologies such as embedded sensors to track vital signs, actuators to control fabric properties, and

conductive fibers for communication or power transfer (Kapoor, 2022). They will be able to gather data on user activity, posture, and environmental conditions, potentially improving overall health and well-being (Deka, 2024). Integrating AR/VR glasses or contacts with smart fabrics featuring haptic feedback will facilitate tactile responses, like vibrations and pulses, allowing for enhanced interactivity and immersion. This technology will offer beneficial guidance during gaming, training, or robotic teleoperation, providing valuable positive or negative feedback and enabling users to navigate intricate tasks effectively (Fersurella et al., 2022).

- **Smart Glasses and Contacts.** AI-driven smart glasses will redefine our future by merging AR and AI technologies to enrich and elevate our daily experiences, transforming the way we interact with the world around us. Augmented reality will blend digital components into our physical environment by superimposing information onto our natural surroundings, creating an immersive and intuitive experience that augments our perception of the world. AI will further enhance this experience by offering contextual awareness, enabling smart glasses to comprehend and anticipate our needs based on our environment, behavior, and emotional state (Orcam, 2024). By 2040, advanced AR contact lenses are also expected to become mainstream. These lenses may offer a variety of features, including facial recognition and real-time subtitle display, zoom capabilities, and health tracking statistics. Users could view text messages directly through the lenses and benefit from image recognition with AI-powered descriptions. Additionally, these lenses would integrate with virtual assistants to provide personalized suggestions and analysis, enhancing the overall user experience (Future Business Tech, 2023). Imagine walking down the street with a Jarvis-like virtual assistant in your smart glasses or contacts, instantly showing names, ratings, and wait times of nearby restaurants based on your preferences and habits. Or, on a historical tour, our glasses will display real-time information about the architecture and history, personalized to our interests. This integration could make digital information anticipatory, enriching our interactions with the world around us (Future Business Tech, 2023).
- **Virtual Reality Headsets.** VR headsets will evolve to be more lightweight and comfortable, providing immersive experiences for learning, gaming, virtual meetings, and remote work environments (Encata Engineering Catalyst, 2023). Future headsets will

be able to integrate with other wearables, such as smart clothing with haptic feedback, to offer more immersive and interactive virtual experiences. In an online discussion about the future of VR, a Redditor by the name of ck-ai (2023) envisioned that by 2040, VR devices may replace traditional displays like TVs and monitors, with virtual keyboards enhanced by machine learning achieving the same level of accuracy as physical keyboards. Daniel D. Bryant, a VR educator and co-founder of *Educators in VR*, predicts that by 2040, the internet will transform from a 2D screen interface to an immersive 3D environment users can enter and explore. He envisions a shift from merely looking at websites through screens to actually stepping into and interacting with them directly. This transformation will be driven by AI, which will create virtual worlds and realistic AI bots to inhabit them (Anderson & Rainie, 2022). VR will also transform social interactions by enabling virtual meetings, conferences, and social gatherings, with 3D holograms becoming a primary mode of communication. Powered by AI, VR headsets will be able to generate and project hyper-realistic holograms of users in real-time to reproduce a person's likeness from multiple reference images. 3D holograms could also potentially replace traditional 2D videos. Imagine controlling 3D scenes with hand gestures—rotating, zooming, and scaling at will. AI advancements could allow real-time customization of these scenes, enabling changes to actors, voices, and weather conditions, delivering an unparalleled level of immersion and interactivity (Future Business Tech, 2023).

- **Brain-Computer Interfaces.** Brain-computer interfaces (BCIs), like Elon Musk's Neuralink (Bowman & Koehler, 2019), enable direct communication between the brain and external devices, allowing users to potentially control computers, smartphones, and other technologies with their thoughts. According to Musk, the goal of Neuralink is to "achieve a symbiosis with artificial intelligence" (para. 1). Using non-invasive (external) and invasive (implanted) BCI technologies, users will be able to access information, make calls, or control devices simply by thinking about them (Norris, 2020). This groundbreaking technology holds significant potential for individuals with disabilities. In medicine, BCIs could be used to treat paralysis, depression, Alzheimer's, and aid stroke recovery, epilepsy management, and neurological disorder treatments (LBN21, 2024). With further advancements in BCI technology, these interfaces would not only address medical conditions

but also augment cognitive capabilities. By 2040, it's plausible that large segments of the population will utilize non-invasive BCI devices for cognitive enhancement purposes, potentially enhancing memory, focus, and learning capabilities. Envision a future where the inability to recall crucial information is obsolete. BCIs could enable users to store and retrieve extensive data seamlessly from external memory banks, all through the power of thought. These advancements could significantly transform education and professional training by enabling institutions to leverage BCIs to accelerate the learning process (LBN21, 2024).

- **Life-Like Virtual Assistants.** By 2040, everyone will have access to a personal digital assistant. These assistants will have evolved into highly customizable 3D avatars featuring individualized appearances, voices, and personalities (George, 2023). Built on advanced language model platforms, these assistants could address almost any query, delivering personalized responses based on individual preferences, goals, and interests. In the not-too-distant future, George (2023) predicts that AI-powered digital assistants will be able to anticipate our needs, delivering tailored recommendations and insights. This shift will gradually render traditional search engines obsolete, as personalized AI assistants become the primary source of information in daily life. AI-powered virtual assistants will significantly impact essential sectors like healthcare and education. In healthcare, they'll offer personalized advice, monitor chronic conditions, and facilitate remote consultations, improving medical access and encouraging self-care (Williams, 2024). In education, AI-driven virtual tutors and learning platforms will customize learning experiences, identify areas for growth, and help students reach academic success. According to Williams (2024), these innovations will transform crucial services, creating a more inclusive and empowered society.

McKinsey & Company's 2023 analysis of AI technologies forecasts that generative AI will attain human-level proficiency in various technical domains, such as social and emotional reasoning, at an accelerated pace. This rapid advancement indicates that AI virtual assistants will evolve to possess emotional intelligence, recognizing and reacting to human emotions with empathy. Picture a future where your Jarvis-inspired virtual assistant is an integral part of your daily life, offering tailored support for work, healthcare, education, and leisure. Judith Donath, a fellow at Harvard's Berkman

Klein Center for Internet and Society imagines a typical day in the life of a user and his personal assistant:

A voice, pleasantly modulated to your aural preference, reminds you to drink more water, helps you choose which gift to buy and provides answers to the innumerable questions, big and small, that pop up in the course of everyday life. (Elon University, 2024, para. 10)

This seamless integration of AI assistance will not only boost productivity and efficiency but also promote a heightened sense of well-being and satisfaction in everyday life.

## The State of the Art of AI in 2040

As we look toward the future of artificial intelligence, it is important to consider the projected advancements and their potential impacts on society. In 2024, Rainie and Anderson conducted a survey of 328 global tech experts to investigate the future challenges and opportunities posed by AI. Their findings suggest that by 2040, AI will have profoundly transformed our daily lives, work, and education (Rainie & Anderson, 2024). Despite ongoing debates about the feasibility and timeline for developing human-level AI, experts like computational cognitive neuroscience researcher and futurist Seth Herd predict “self-improving artificial general intelligence (AGI) within three to 15 years” (p. 88). Kunle Olorundare, president of the Nigeria Chapter of the Internet Society, envisions AI technologies becoming integrated into all aspects of life, automating many production tasks and addressing global challenges like climate change and poverty (p. 88). Axel Bruns, a professor of digital media, adds that “LLMs (AIs trained on large learning models) are getting easier and cheaper to build and run” (p. 91). Philippa Smith, a digital media expert, asserts that by 2040, AI will be “so ingrained in individuals’ daily lives that it will have become normalized, accepted and expected” (p. 96), akin to how the internet revolutionized various facets of life. She observed,

Parallels can be seen in our experiences with the advent of the internet as it took us down new pathways in how we learned,

were informed and entertained, how we communicated with our social networks, did our purchasing and banking, sourced our news, organised holidays, sought medical advice or engaged with government departments and organisations. (p. 96)

While making large language models reliable and trustworthy will remain a challenge, advancements in AI technology and improved fact-checking by 2040 will significantly improve the accuracy and reliability of AI outputs, with new methods being developed to detect and mitigate hallucinations and misinformation (University of Oxford, 2024). When asked about the accuracy of AI-generated content, OpenAI's CEO Sam Altman says that ChatGPT is “the dumbest model... you will ever have to use,” but promises better performance and accuracy from GPT-5 and subsequent models, underscoring the inherent, evolving nature of AI technology and software development in general (Okemwa, 2024, para. 3). Bill Gates has also expressed a positive outlook on the ethical and transparent development of AI. While recognizing AI's potential for misinformation and biases, he remains optimistic that these issues can be addressed in the future (Torres, 2023). The key to mitigating misinformation and biases in AI, according to a survey of AI experts, lies in ensuring that factual information is “appropriately verified, highly findable, well-updated, and archived” (Anderson & Rainie, 2023). By prioritizing accuracy, trustworthiness, and ethical considerations in AI development, researchers, technology companies, and policymakers can drive advancements in AI technology to foster a more promising and responsible AI-driven future.

Building on these foundational efforts, perhaps one of the most exciting and promising developments in the development of AI systems is the development of *artificial general intelligence* (AGI). AGI refers to a form of artificial intelligence that possesses the ability to understand, learn, and apply knowledge across a wide range of tasks at a level comparable to or surpassing that of humans (Zohuri & Behgounia, 2023). Unlike current AI systems which excel at specific tasks, AGI will be capable of generalizing knowledge and adapting to new situations, enabling it to perform any intellectual task that a human can do (Morris et al., 2023).

Although true AGI does not yet exist, current AI systems, known as narrow AI, can perform specific tasks exceptionally well but lack

the comprehensive cognitive abilities of AGI. Experts have varying opinions on when AGI might be developed, with estimates ranging from years or decades to over a century, and some doubting its feasibility altogether. The 2022 Expert Survey on AI Progress (Grace et al., 2022), which surveyed 738 experts, found that AI specialists estimate a 50% chance that high-level machine intelligence will emerge by 2059. Geoffrey Hinton, often referred to as the “godfather of artificial intelligence,” suggested in an interview with CBS journalist Brook Silva-Braga, that advancements in AI could be as transformative as the Industrial Revolution, electricity, or even the invention of the wheel. He remarked, “Until quite recently, I thought it was going to be like 20 to 50 years before we have general-purpose AI. And now I think it may be 20 years or less” (CBS News, 2023). OpenAI CEO Sam Altman believes that AGI can be achieved even sooner, within the next decade (PYMNTS, 2024). He observed, “We believe that providing people with better tools leads to astonishing achievements... and AGI will be the greatest tool humanity has ever created” (para. 7). Currently at Level 1, where AI can interact conversationally with humans, the company says it’s advancing to Level 2, matching the problem-solving capacity of a PhD-level expert. Future levels envision AI systems acting on behalf of users for extended periods (Level 3), innovating (Level 4), and ultimately, at Level 5, performing the tasks of an entire organization (PYMNTS, 2024). In a recent Reuters technology article (2024), Elon Musk also weighed in on the timeline for AGI development, stating, “If you define AGI (artificial general intelligence) as smarter than the smartest human, I think it’s probably next year, within two years” (para. 3).

Regardless of when or whether AGI is achieved, the years leading up to 2040 are anticipated to see rapid advancements in AI capabilities. These significant developments have the potential to bring about transformative societal changes, even without the realization of true AGI.

## The Future of Education: AI-Driven Transformation by 2040

By 2040, artificial intelligence will fundamentally reshape the education sector, revolutionizing both teaching and learning experiences. This

revolution will bring forth unparalleled customization, streamlined administration, and sophisticated data analytics. Among the key aspects of this shift will be AI-powered tutoring systems, tailored assessments, immersive learning experiences, and adaptive educational platforms. These advancements will help to create a more inclusive, effective, and personalized learning environment. By 2040, AI is set to revolutionize education, with notable transformations in the following areas:

### *Personalization of Learning*

By 2040, sophisticated AI algorithms will be able to analyze individual student data with unprecedented precision. At its core, *personalized learning* acknowledges the unique needs and attributes of each student, including their learning style preferences, pacing, and interests (Zhao, 2024). This recognition challenges the traditional focus on uniform academic outcomes, advocating for a shift towards tailored instruction to better accommodate individual differences. Yet, according to Zhao (2024), true *personalization* goes beyond traditional personalized learning pedagogy. Rather than guiding everyone toward the same standardized goals, it focuses on helping “each student to become uniquely great in their own way” (p. 3). Thus, the aim of modern education would be to nurture individuals’ unique strengths, rather than simply preparing them to become “average members of a workforce” (p. 4).

Imagine a futuristic classroom where AI-driven platforms tailored lessons to each student’s progress, shifting the focus from fixing deficiencies to nurturing individual strengths, enabling all learners to excel in their unique talents. Imagine a curriculum powered by AI that granted students more control of their learning. Zhao (2021) envisions personalized learning as a tool to empower students to develop their unique strengths and pursue their individual interests. For example, instead of strictly following a standardized curriculum that imposes identical content on all students, Zhao proposes that 60% of the curriculum be set by governments and schools. The remaining 40% would allow students to use AI and other resources to explore beyond conventional subjects, crafting a learning journey tailored to their passions and strengths. Picture the following scenario as an illustration of AI-driven

personalization that fosters learning experiences uniquely tailored to individual students' strengths and interests.

### Scenario 1: Personalization of Learning in 2040

Envision a classroom where three students, Alex, Maya, and Jordan, exemplify the power of personalized learning by exploring the same topic—environmental sustainability—in completely different ways, tailored to their unique strengths and interests.

Alex, a hands-on learner, thrives in practical settings. The AI platform suggests a series of interactive projects, leading Alex to build a small aquaponics system at home. Through this hands-on approach, Alex gains engineering and problem-solving experience while learning about sustainability.

Maya, a visual and artistic learner, is passionate about art. Her AI platform recommends creating a digital art series depicting the impacts of climate change. Maya merges her artistic talents with environmental advocacy as she researches scientific aspects of climate change, translating them into captivating artwork.

Jordan, an analytical thinker, excels in research and data analysis. His AI platform proposes a detailed analysis of global energy consumption trends. With guidance from AI-driven data analysis tools and connections to environmental science experts, Jordan hones critical thinking and data science skills while studying sustainability.

In this futuristic classroom, AI-driven personalization empowers Alex, Maya, and Jordan to explore environmental sustainability in ways that align with their strengths, nurturing their talents while fostering a deep understanding of a critical issue.

Through adaptive assessments, AI can track student progress through their learning journeys and adapt lessons to maximize learning. Daniel Bron (2023), an AI and quantum computing enthusiast, entrepreneur, and author, foresees future AI systems transforming personalized learning, leveraging real-time performance predictions and interventions to foster improved student outcomes via data-driven,

adaptable educational approaches. Teachers would harness data-driven insights to monitor student development and tailor their teaching strategies, ensuring each student receives the support they need.

### *Intelligent Tutoring Systems*

By 2040, ITS are expected to play a significant role in the true personalization of education. As noted by Bron (2023), ITS epitomize AI's potential in education by transforming how students learn and interact with educational content, adapting to individual learners' needs in real-time. These systems will not only save time for educators, but also provide precise and consistent feedback for students (Bron, 2023). Akyuz (2020) highlights that ITS can significantly enhance personalized learning by offering several advantages. They keep students engaged longer, allow them to learn at their own pace, and make learning more interactive. ITS can also provide continuous user support and enable learning at any time, even on the go.

Over time, ITS can reduce costs by preserving training materials for future use, promoting more efficient time and resource management. By automating routine tasks like grading and assessments, ITS will allow educators to dedicate more time to complex teaching responsibilities, such as mentoring and inspiring students. This shift can create a more efficient educational environment where teachers use AI tools to enhance their teaching strategies and provide more personalized support to their students (Bron, 2023). The following scenario exemplifies the potential of AI-driven ITS in real-time diagnosis and adaptation of instruction to cater to individual learners' needs.

### **Scenario 2: Intelligent Tutoring Systems in 2040**

Envision a classroom where an ITS helps students like Emma and Lucas master advanced calculus, specifically multivariable functions, by tailoring learning experiences to their unique needs.

Emma experiences anxiety with complex equations and needs visual aids for understanding, while Lucas struggles to apply theoretical knowledge to real-world situations.

The ITS assesses their learning styles, preferences, and current understanding, generating personalized learning paths. Emma's path starts with interactive visualizations, gradually introducing equations. Lucas's path focuses on real-world scenarios applying multivariable functions.

Throughout their learning journey, the ITS administers adaptive assessments and provides detailed feedback. It also offers mentorship and support, such as relaxation exercises for Emma and additional resources for Lucas.

After several weeks, both students show significant improvement. Emma has developed a better understanding of multivariable functions and gained confidence, while Lucas has successfully applied theoretical knowledge to practical situations. The personalized approach of the ITS has made learning more meaningful and effective for both students.

As we approach 2040, ITS have the potential to radically impact education with real-time tailored learning, consistent feedback, and automation of routine tasks, freeing educators to focus on mentoring and creating engaging and successful learning experiences for all learners.

### *Adaptive Learning Platforms*

By 2040, adaptive learning platforms are expected to advance significantly due to developments in artificial intelligence. Woldetsadik (2024) suggests that these platforms will be capable of identifying knowledge gaps, offer personalized recommendations, and provide real-time feedback to both students and teachers. As these systems evolve, they will increasingly adjust the difficulty and pace of lessons based on students' real-time performance, ensuring each student receives the appropriate level of support and challenge for optimal learning outcomes (Manoharan, 2024). Powered by sophisticated algorithms, Evanick (2024) describes how adaptive learning systems utilize extensive data sets to evaluate factors such as response accuracy, time taken to respond, error patterns, and levels of engagement. Based

on this analysis, the system adjusts task difficulty, suggests additional resources, and delivers personalized feedback to enhance the learning experience. As adaptive learning evolves, the integration of VR and AR will pave the way for more immersive educational experiences. In this envisioned future, students will interact with AI tutors in VR simulations to dissect complex scientific concepts via AR interfaces for real-time feedback (Evanick, 2024).

In the future, AI will play a pivotal role in making education more inclusive by adapting to diverse individual needs, such as disabilities, language differences, and unique personal characteristics. Advanced AI algorithms will be able to tailor learning experiences to better support students with disabilities and multilingual learners. These AI systems will be optimized for neurodiverse students, offering multiple learning paths and interaction methods, ensuring that all learners have equitable access to high-quality, personalized resources (US Department of Education, Office of Educational Technology, 2023). Using AI as a support tool, educators can assist in the development of individualized education plans (IEPs) for students with disabilities. By analyzing performance data, AI can assist in identifying specific learning goals and monitoring progress, ensuring that all students receive the customized support necessary for their success (Michels & Truger, 2024). Consider the following scenario as an illustration of the transformative potential of AI-assisted adaptive learning platforms in education.

### Scenario 3: Adaptive Learning Platforms in 2040

This case study explores how these AI-driven systems transform the learning experiences of three students.

Sarah is a neurodiverse student with dyslexia who has always struggled with reading and writing in traditional classroom settings. The conventional pace and teaching methods have often left her feeling overwhelmed and frustrated.

Juan is a multilingual learner whose first language is Spanish. While he is proficient in English, he sometimes struggles with complex vocabulary and concepts, which affects his overall academic performance.

Amina has a physical disability that limits her ability to participate in certain classroom activities. Traditional learning environments have often required physical adaptations that don't fully meet her needs.

For Sarah, the adaptive learning platform identifies Sarah's difficulties with reading and writing by analyzing her response accuracy, time taken to complete tasks, and patterns of mistakes. The system then adjusts the difficulty of her reading materials, offering audio support and visual aids to help her better understand the content. The platform also provides real-time feedback, helping Sarah improve her literacy skills at her own pace.

For Juan, the platform recognizes his language background and adjusts the lessons to include bilingual support, offering explanations in both English and Spanish. This dual-language approach helps Juan grasp complex concepts more effectively.

Amina's adaptive learning platform integrates VR and AR to create immersive educational experiences that do not rely on physical participation. The platform also provides real-time feedback and adjusts the tasks to suit her physical capabilities, ensuring that she receives the same educational opportunities as her peers, without the limitations imposed by her physical disability.

The adaptive learning platform proved valuable not only for the students but also for Mr. Johnson, their teacher. With AI-driven analysis of real-time student data, Mr. Johnson was able to set personalized goals and monitor progress more effectively. Automation of tasks like grading enabled him to focus more on mentoring, which improved student engagement and enhanced the learning experience.

By 2040, adaptive learning platforms will evolve to offer enhanced personalization, real-time feedback, and advanced technological integration, significantly improving accessibility for students with disabilities. These advancements will lead to a more inclusive and effective educational environment.

## Learning Everything Everywhere All at Once

By 2040, AI will eliminate barriers and provide global access to high-quality education. Real-time curricula updates and personalized learning experiences will cultivate a continuous learning mindset. AI's focus on knowledge transfer will empower students to drive their education, accessing world-class resources tailored to their unique needs.

Nikolas Kairinos (2020), CEO and founder of Soffos, the world's first AI-powered KnowledgeBot, envisions a world where "the physical boundaries of education will soon be eradicated," leveling the playing field by providing equal access to top-notch educational materials and teaching methodologies across the globe (para. 7). When reflecting upon how curricula could be updated in real-time to provide the most up-to-date knowledge, Kairinos (2020) observed:

The answer lies in leveraging AI solutions that can collect all the data available globally, instantaneously. Every day, students will be offered the most up-to-date information that exists to ensure that they never fall behind. Even better, AI toolsets will present the information in a way that resonates with each individual. After all, while making notes during live lectures might work well for some, others prefer to learn visually or through interactive activities. While the concepts taught will be the same, the way they are presented will be based on the unique learning styles of every student. (para. 13)

Although education is often equated with formal schooling, learning is a lifelong process that extends beyond the classroom (Kaplan, 2024). It continues well after graduation, encompassing various forms of personal and professional growth. Kairinos (2020) recognizes the need for a paradigm shift in education as rapid information sharing renders knowledge outdated at an unprecedented pace. The traditional notion of finite learning periods is being replaced by a continuous, lifelong education model, which is critical for maintaining professional competency and fostering growth. As education evolves to meet the demands of a rapidly changing world, the integration of AI and technology is expected to play a pivotal role in supporting lifelong learning.

Eugenia Rho, Professor of Computational Social Science and Human-Computer Interaction at Virginia Tech, envisions personal assistants having human-like dynamic conversations with their users. “Imagine having a resource—not quite a friend but a helpful tool—ready to assist when you need insights or a different perspective” (Virginia Tech Engineer, 2023, para. 8). The following scenario illustrates how AI can blend into daily life to support lifelong learning, ensuring continuous growth and educational opportunities.

#### ***Scenario 4: Learning Everything Everywhere All at Once***

Imagine waking up in the year 2040, where lifelong learning is seamlessly integrated into every facet of your daily life. As you begin your day, you interact with a cognitive brain interface (CBI), a non-invasive device that enhances your cognitive functions, helping you process and retain information more effectively. Whether you’re reading the news, exploring a new skill, or diving into a complex topic, the CBI supports your learning by optimizing how your brain absorbs and applies new knowledge.

Throughout your day, your personal AI mentor is always within reach. This AI is tailored to your unique learning needs and preferences, offering guidance and support as you navigate various informal learning experiences. When a question arises or you need advice on a topic, your AI mentor provides instant, personalized answers, helping you deepen your understanding and stay on track with your learning goals.

Language is no barrier to your quest for knowledge. With real-time language translation devices integrated into your smart glasses, you can access global knowledge and engage with diverse content from around the world. Whether you’re watching a lecture from a university in Japan or reading an article from a German research institute, the translation happens effortlessly, allowing you to learn from a multitude of sources without language limitations.

As you go about your day, a smart wearable device continuously monitors your cognitive and emotional states. It understands when you're most receptive to learning and when you might need a break. If the device detects that you're particularly focused, it might suggest diving into a challenging topic or project. Conversely, if it senses that you're feeling fatigued or stressed, it might prompt you to take a short walk or switch to a lighter, more relaxing activity. This ensures that your learning is both effective and sustainable.

Every interaction and experience is an opportunity to learn, thanks to AR overlays that enhance your understanding of the world around you. As you explore your environment, AR provides contextual information—historical data, scientific explanations, or even creative insights—directly within your field of vision. Whether you're walking through a city, visiting a museum, or working on a hands-on project, AR transforms everyday activities into rich, immersive learning experiences.

In this future, learning is not confined to classrooms or formal education. Instead, it's woven into the fabric of daily life, supported by cutting-edge technologies that adapt to your needs, preferences, and circumstances. This continuous, informal learning approach empowers you to stay relevant, curious, and skilled, no matter where life takes you.

The widespread availability of AI-powered educational tools will revolutionize learning, dismantling barriers, and enabling individuals to pursue education beyond traditional schooling (Kairinos, 2020). By facilitating lifelong learning, these platforms encourage a transformation in the way we acquire knowledge, focusing on continuous, adaptive learning experiences driven by self-direction, iteration, and social engagement (Loew, 2024). As AI solutions reshape how we measure understanding, the era of *next-level continuous learning* becomes a reality.

As per Loew (2024), the future of continuous learning diverges from traditional models by focusing on self-directed, iterative, and socially engaging experiences. In this model, naturally curious self-directed learners take the initiative in their personal and professional

development, constantly asking questions and finding ways to apply their learning across different contexts. Iterative learners view life and work as continuous growth opportunities, focusing on grasping the core of problems. They learn through trial and error, appreciating failure's role in refining their methods. Socially driven learners prioritize diverse perspectives and collaboration, building meaningful connections and actively seeking insights from various sources to enhance their learning experience.

For lifelong learners, AI will play a pivotal role, acting as a virtual guide that offers curated materials, suggests suitable courses, and continuously adapts to learners' evolving needs and interests (Analytikus, 2023). By integrating AI into education, learning becomes an individualized, dynamic journey that caters to the distinct requirements and preferences of each learner.

## Summary

As we look towards 2040, the landscape of education is poised for a dramatic transformation driven by artificial intelligence and advanced technologies. This evolution will reshape how we learn, teach, and interact with knowledge throughout our lives.

Key emerging trends include AI-driven personalized learning, ITS, and adaptive platforms that tailor education to individual needs, styles, and pacing. These systems will provide real-time feedback and adapt content difficulty to optimally challenge and support each learner. AI will also enhance inclusivity, catering to diverse needs such as disabilities and language differences. Integration of AI with wearable tech will enable continuous learning beyond classrooms, while immersive technologies like VR and AR will create highly engaging learning environments. AI-powered translation and personalization will transcend geographical and language barriers, providing global access to high-quality, real-time updated resources.

As we embrace the benefits of AI in education, we must also consider potential challenges that emerge from this transformative shift. Data privacy and security are paramount, as integrating AI involves handling sensitive student information. Establishing proper safeguards

to protect this data is essential. The evolving role of educators in AI-enhanced learning must also be considered. While AI can offer personalized instruction, it cannot fully replace human elements such as empathy and creativity. Balancing technology-assisted learning with these irreplaceable human aspects will be vital for a comprehensive learning experience. Addressing disparities in access to AI-powered resources will be critical to ensure equal opportunities for all learners. By promoting inclusive education, we can prevent existing inequalities from widening.

By embracing artificial intelligence and advanced technologies thoughtfully and responsibly, we have the opportunity to truly revolutionize education, fostering a society of lifelong learners equipped to thrive in an ever-changing world. The journey to 2040 promises to be an exciting one, full of possibilities for reimagining how we acquire, process, and apply knowledge throughout our lives.

## Discussion Questions

1. How might the widespread adoption of AI-driven personalized learning systems impact the role of human educators by 2040? What new responsibilities might educators take on in this AI-enhanced learning environment?
2. This chapter envisions a future where AI facilitates continuous, self-directed learning. How could this shift in educational paradigms impact the way we measure academic success and learning achievements in higher education?
3. Discuss the potential societal impacts of AI-facilitated lifelong learning. How might this shift affect traditional educational institutions, job markets, and social mobility?
4. Considering the potential for AI to offer real-time curriculum updates, what are the implications for curriculum design and the role of educators in ensuring that content remains relevant and up to date?
5. Compare and contrast the benefits and drawbacks of immersive, AI-driven virtual learning environments with traditional in-person education. How can we design future educational systems that effectively blend the best aspects of both approaches?

## References

Akyuz, Y. (2020). Effects of intelligent tutoring systems (ITS) on personalized learning (PL). *Creative Education*, 11(6), 953–978. <https://doi.org/10.4236/ce.2020.116069>

American College of Sports Medicine. (2023, December). *Wearable technology named top fitness trend for 2024*. [www.acsm.org/news-detail/2023/12/28/wearable-technology-named-top-fitness-trend-for-2024](https://www.acsm.org/news-detail/2023/12/28/wearable-technology-named-top-fitness-trend-for-2024)

Analytikus. (2023, December). *Lifelong learning in the age of AI: Navigating the future with analytics*. [www.analytikus.com/post/lifelong-learning-in-the-age-of-ai-navigating-the-future-with-analytics](https://www.analytikus.com/post/lifelong-learning-in-the-age-of-ai-navigating-the-future-with-analytics)

Anderson, J., & Rainie, L. (2022, June). *The metaverse in 2040*. Pew Research Center. [www.pewresearch.org/internet/2022/06/30/the-metaverse-in-2040/](https://www.pewresearch.org/internet/2022/06/30/the-metaverse-in-2040/)

Anderson, J., & Rainie, L. (2023, June). *As AI spreads, experts predict the best and worst changes in digital life by 2035*. Pew Research Center. [www.pewresearch.org/internet/2023/06/21/as-ai-spreads-experts-predict-the-best-and-worst-changes-in-digital-life-by-2035/](https://www.pewresearch.org/internet/2023/06/21/as-ai-spreads-experts-predict-the-best-and-worst-changes-in-digital-life-by-2035/)

Bowman, M. W., & Koehler, J. (2019, July). Elon Musk announces plan to “merge” human brains with AI. *Motherboard*. [www.vice.com/en/article/7xgnxd/elon-musk-announces-plan-to-merge-human-brains-with-ai](https://www.vice.com/en/article/7xgnxd/elon-musk-announces-plan-to-merge-human-brains-with-ai)

Bron, D. (2023, June). The classrooms of 2040—How will technology shape the next generation? *LinkedIn*. [www.linkedin.com/pulse/classrooms-2040-how-technology-shape-next-generation-daniel-bron/](https://www.linkedin.com/pulse/classrooms-2040-how-technology-shape-next-generation-daniel-bron/)

The Business Paradox. (2023, September). Getting to know “phygital”—And how it all began. *The Business Paradox*. <https://thebusinessparadox.com/getting-to-know-phygital-and-how-it-all-began/>

CBS News. (2023, March). “Godfather of artificial intelligence” weighs in on the past and potential of AI. *CBS Saturday Morning*. [www.cbsnews.com/news/godfather-of-artificial-intelligence-weighs-in-on-the-past-and-potential-of-artificial-intelligence/](https://www.cbsnews.com/news/godfather-of-artificial-intelligence-weighs-in-on-the-past-and-potential-of-artificial-intelligence/)

ck-ai. (2023, October 15). What are your predictions regarding VR headsets in 2040. *Reddit*. [www.reddit.com/r/virtualreality/comments/17gchcj/what\\_are\\_your\\_predictions\\_regarding\\_vr\\_headsets/](https://www.reddit.com/r/virtualreality/comments/17gchcj/what_are_your_predictions_regarding_vr_headsets/)

Deka, D. (2024, March). The symbiotic aesthetic: Fashion merges with wearable tech in 2040. *LinkedIn*. [www.linkedin.com/pulse/symbiotic-aesthetic-fashion-merges-wearable-tech-2040-debajit-deka-nbxsc/](https://www.linkedin.com/pulse/symbiotic-aesthetic-fashion-merges-wearable-tech-2040-debajit-deka-nbxsc/)

Eadicicco, L. (2024, January). Your future phone will likely be smarter, faster and more flexible. *CNET*. [www.cnet.com/tech/mobile/your-next-phone-will-likely-be-smarter-faster-and-more-bendy/](https://www.cnet.com/tech/mobile/your-next-phone-will-likely-be-smarter-faster-and-more-bendy/)

edCircuit. (2023, March). *The rising phygital student—Physical and digital*. <https://edcircuit.com/rising-phygital-student/> #:~:text=This%20has%20coined%20the%20term,within%20the%20school%20or%20institution

Elon University. (2024). “AI impact by 2040”: Experts share scenarios, describe how things might play out. Imagining the Digital Future Center. <https://imaginethedigitalfuture.org/reports-and-publications/the-impact-of-artificial-intelligence-by-2040/a-selection-of-future-scenarios-how-things-might-play-out/>

Encata Engineering Catalyst. (2023, November). The future of wearable technology: Trends and possibilities. *Encata*. [www.encata.net/blog/the-future-of-wearable-technology-trends-and-possibilities](http://www.encata.net/blog/the-future-of-wearable-technology-trends-and-possibilities)

Evanick, J. (2024, June). *Enhancing student engagement and achievement through AI-powered adaptive learning systems*. eLearning Industry. <https://elearningindustry.com/enhancing-student-engagement-and-achievement-through-ai-powered-adaptive-learning-systems>

Fersurella, G., Della Torre, A., Quaranta, F., Losito, P., D’Alessandro, L., Invitto, S., & Rinaldi, R. (2022). A wearable and smart actuator for haptic stimulation. *Micro and Nano Engineering*, 16, 100161. <https://doi.org/10.1016/j.mne.2022.100161>

Future Business Tech. (2023, February). Augmented reality in 2040: Top 9 future technologies. *Future Business Tech*. [www.futurebusinesstech.com/blog/augmented-reality-in-2040-top-9-future-technologies](http://www.futurebusinesstech.com/blog/augmented-reality-in-2040-top-9-future-technologies)

George, R. (2023, June). Revolutionizing the future: 20 technologies to shape the world in 2040. *LinkedIn*. [www.linkedin.com/pulse/revolutionizing-future-20-technologies-shape-world-2040-roshan-george/](http://www.linkedin.com/pulse/revolutionizing-future-20-technologies-shape-world-2040-roshan-george/)

Grace, K., Stein-Perlman, Z., Weinstein-Raun, B., & Salvatier, J. (2022, August 3). 2022 expert survey on progress in AI. *AI Impacts*. <https://aiimpacts.org/2022-expert-survey-on-progress-in-ai/>

Graham, J. (2020, February). A leap into the unknown: How “design fiction” is shaping our future. *Neste*. [www.neste.com/en-us/news-and-insights/innovation/leap-unknown-how-design-fiction-shaping-our-future](http://www.neste.com/en-us/news-and-insights/innovation/leap-unknown-how-design-fiction-shaping-our-future)

Hughes, M. (2023, February). Futurist says smartphones will be extinct by 2040. We’re calling BS. *KnowTechie*. <https://knowtechie.com/futurist-says-smartphones-to-become-extinct-by-2040/>

Humane. (n.d.). *Humane AI pin*. <https://humane.com>

Kairinos, N. (2020, July). What will education look like in 2040? *FE News*. [www.fenews.co.uk/exclusive/what-will-education-look-like-in-2040/](http://www.fenews.co.uk/exclusive/what-will-education-look-like-in-2040/)

Kaplan, Z. (2024, July). *What is lifelong learning? (And how to do it yourself)*. *Forage*. [www.theforage.com/blog/basics/lifelong-learning](http://www.theforage.com/blog/basics/lifelong-learning)

Kapoor, S. (2022, November). Start-ups leveraging technologies in smart textiles. *Apparel Resources*. <https://apparelresources.com/technology-news/retail-tech/start-ups-leveraging-technologies-smart-textiles/>

Kirby, D. (2010). The future is now: Diegetic prototypes and the role of popular films in generating real-world technological development. *Social Studies of Science*, 40(1), 41–70. <https://doi.org/10.1177/0306312709338325>

Kumar, A. (2023, December). The future of education: The convergence on phygital. *Medium*. <https://medium.com/@aroonin/the-future-of-education-the-convergence-on-phygital-a81d63e77d60>

LBN21. (2024, July). The mind machine merge: How brain computer interfaces will revolutionize healthcare by 2040. *LBN21 TechnoFuturist Forecasts*. [www.lbn21.com/technofuturist-forecasts/the-mind-machine-merge-how-brain-computer-interfaces-will-revolutionize-healthcare-by-2040](http://www.lbn21.com/technofuturist-forecasts/the-mind-machine-merge-how-brain-computer-interfaces-will-revolutionize-healthcare-by-2040)

Lee, K. (2024, May). Smart rings: The new wearable trend. *LinkedIn*. [www.linkedin.com/pulse/smart-rings-new-wearable-trend-kyson-lee-uc2yc/](http://www.linkedin.com/pulse/smart-rings-new-wearable-trend-kyson-lee-uc2yc/)

Loew, L. (2024, May). Next-level continuous learning is essential for successful businesses. *Forbes*. [www.forbes.com/sites/forbeshumanresourcecouncil/2024/05/23/next-level-continuous-learning-is-essential-for-successful-businesses/](http://www.forbes.com/sites/forbeshumanresourcecouncil/2024/05/23/next-level-continuous-learning-is-essential-for-successful-businesses/)

Manoharan, A. (2024, June). *Next-gen education: 8 strategies leveraging AI in learning platforms*. Forbes Technology Council. [www.forbes.com/sites/forbestechcouncil/2024/06/04/next-gen-education-8-strategies-leveraging-ai-in-learning-platforms/](http://www.forbes.com/sites/forbestechcouncil/2024/06/04/next-gen-education-8-strategies-leveraging-ai-in-learning-platforms/)

Marr, B. (2020, June). 5 predictions for wearable technology: From fitness trackers to “Humans 2.0.” *Forbes*. [www.forbes.com/sites/bernardmarr/2020/06/08/5-predictions-for-wearable-technology-from-fitness-trackers-to-humans-20/](http://www.forbes.com/sites/bernardmarr/2020/06/08/5-predictions-for-wearable-technology-from-fitness-trackers-to-humans-20/)

Maxicus. (n.d.). Phygital: A definitive guide. <https://maxicus.com/phygital-a-definitive-guide/#:~:text=Phygital%20is%20a%20term%20coined,create%20a%20seamless%2C%20unified%20experience>

McKinsey & Company. (2023, August). *What's the future of generative AI? An early view in 15 charts*. [www.mckinsey.com/featured-insights/mckinsey-explainers/whats-the-future-of-generative-ai-an-early-view-in-15-charts](http://www.mckinsey.com/featured-insights/mckinsey-explainers/whats-the-future-of-generative-ai-an-early-view-in-15-charts)

Michels, C., & Truger, A. (2024, March). Using AI to save time and reduce the workload when writing IEPs. *Edutopia*. [www.edutopia.org/article/using-ai-write-ieps-help-educators-reduce-workload/](http://www.edutopia.org/article/using-ai-write-ieps-help-educators-reduce-workload/)

Morris, M. R., Sohl-Dickstein, J. N., Fiedel, N., Warkentin, T. B., Dafoe, A., Faust, A., Farabet, C., & Legg, S. (2023). Levels of AGI for operationalizing progress on the path to AGI. *arXiv preprint arXiv:2311.02462*.

Norris, M. (2020, August). Brain–computer interfaces are coming. Will we be ready? RAND. [www.rand.org/pubs/articles/2020/brain-computer-interfaces-are-coming-will-we-be-ready.html](http://www.rand.org/pubs/articles/2020/brain-computer-interfaces-are-coming-will-we-be-ready.html)

Okemwa, K. (2024, May). OpenAI CEO Sam Altman promises “with a high degree of scientific certainty” that GPT-5 will be smarter than the “mildly embarrassing at best” GPT-4. Windows Central. [www.windowscentral.com/software-apps/openai-ceo-sam-altman-promises-gpt-5-will-be-smarter-than-gpt-4](http://www.windowscentral.com/software-apps/openai-ceo-sam-altman-promises-gpt-5-will-be-smarter-than-gpt-4)

Orcam. (2024, March). *The future is now: Unveiling the next gen of smart glasses.* [www.orcam.com/en-us/blog/future-of-smart-glasses](http://www.orcam.com/en-us/blog/future-of-smart-glasses)

PYMNNTS. (2024, July). *OpenAI director says artificial general intelligence may be 5 years out.* [www.pymnts.com/artificial-intelligence-2/2024/openai-board-member-agi-is-five-to-15-years-away/](http://www.pymnts.com/artificial-intelligence-2/2024/openai-board-member-agi-is-five-to-15-years-away/)

Rainie, L., & Anderson, J. (2024, February 29). *Experts imagine the impact of artificial intelligence by 2040.* Imagining the Digital Future Center. <https://imaginingthedigitalfuture.org/wp-content/uploads/2024/02/AI2040-FINAL-White-Paper-2-2.29.24.pdf>

Reuters. (2024, April). Tesla’s Musk predicts AI will be smarter than the smartest human next year. *Reuters, Technology.* [www.reuters.com/technology/teslas-musk-predicts-ai-will-be-smarter-than-smartest-human-next-year-2024-04-08/](http://www.reuters.com/technology/teslas-musk-predicts-ai-will-be-smarter-than-smartest-human-next-year-2024-04-08/)

Rutnik, M. (2022, May). What will smartphones of the future look like? Here are 6 (crazy) predictions. *Android Authority.* [www.androidauthority.com/future-phones-927528/](http://www.androidauthority.com/future-phones-927528/)

Sterling, B. (2005). *Shaping things.* MIT Press. [https://wtf.tw/ref/sterling\\_shaping\\_things.pdf](https://wtf.tw/ref/sterling_shaping_things.pdf)

Sterling, B. (2013, October). Patently untrue: Fleshy defibrillators and synchronised baseball are changing the future. *Wired.* [www.wired.com/story/patently-untrue/](http://www.wired.com/story/patently-untrue/)

Torres, J. (2023, July). Bill Gates takes on the future of artificial intelligence. *CMSWire.* [www.cmswire.com/digital-experience/5-bill-gates-takes-on-the-future-of-artificial-intelligence/](http://www.cmswire.com/digital-experience/5-bill-gates-takes-on-the-future-of-artificial-intelligence/)

University of Oxford. (2024, June). *Major research into “hallucinating” generative models advances reliability of artificial intelligence.* [www.ox.ac.uk/news/2024-06-20-major-research-hallucinating-generative-models-advances-reliability-artificial?ref=image](http://www.ox.ac.uk/news/2024-06-20-major-research-hallucinating-generative-models-advances-reliability-artificial?ref=image)

US Department of Education, Office of Educational Technology. (2023). *Artificial intelligence and the future of teaching and learning: Insights and recommendations.* [www2.ed.gov/documents/ai-report/ai-report.pdf](http://www2.ed.gov/documents/ai-report/ai-report.pdf)

Virginia Tech Engineer. (2023). *AI—The good, the bad, and the scary*. <https://eng.vt.edu/magazine/stories/fall-2023/ai.html>

Williams, S. (2024, February). The future of AI-powered virtual assistants in enhancing everyday life. *Medium*. <https://medium.com/@StephanyWilliamsWrites/the-future-of-ai-powered-virtual-assistants-in-enhancing-everyday-life-2ca8b50580a0>

Woldetsadik, M. (2024, August). *The impact of artificial intelligence by 2040: Transforming industries and shaping the future*. [https://mylibrarianship.wordpress.com/2024/03/01/latest-research\\_the-impact-of-artificial-intelligence-by-2040-transforming-industries-and-shaping-the-future/](https://mylibrarianship.wordpress.com/2024/03/01/latest-research_the-impact-of-artificial-intelligence-by-2040-transforming-industries-and-shaping-the-future/)

Zarkov, G. (2018, August). What will the smartphones of 2040 be like? Here's our wild guess. *Phone Arena*. [www.phonearena.com/news/the-smartphone-one-of-the-future-wild-speculations\\_id107482](http://www.phonearena.com/news/the-smartphone-one-of-the-future-wild-speculations_id107482)

Zhao, Y. (2021). *Learners without borders: New learning pathways for all students*. Corwin.

Zhao, Y. (2024). Artificial intelligence and education: End the grammar of schooling. *ECNU Review of Education*, 1(18). Sage. <https://doi.org/10.1177/20965311241265124>

Zohuri, B., & Behgounia, F. (2023). Application of artificial intelligence driving nano-based drug delivery system. In A. Philip, A. Shahiwala, M. Rashid, & M. Faiyazuddin (Eds.), *A handbook of artificial intelligence in drug delivery* (pp. 145–212). Academic Press. <https://doi.org/10.1016/B978-0-323-89925-3.00007-1>

# Index

*Note: Bold* page numbers indicate tables, *italic* numbers indicate figures.

Abramson, A. 13  
academic integrity: cheating, policies and 125–127; concerns about 215–216; educative approach to 216–217; revision of policies 132  
academic writing 122–125  
access to technology/internet/AI: assessment and 301; bias in AI systems 318–319; connectivity disparities 314–315; digital divide 310–311, 313; disabilities, student with 319–320, 322; disparities in 314–316; equitable 108–109; future of AI 379; institutional policies 149; for knowledge workers 333; minority groups 318–320; teaching about AI 219–220  
accountability: debiasing and 184–185; institutional policies 148, 153–154  
accuracy of content 71–72, 373  
Adams, C. 31  
adaptability 271–272; in a changing world 94; as core competency 338, 341  
adaptive learning: institutional transformation and 35; personalized instruction and learning 30, 36, 53; platforms 95, 378–380; tools 52  
Adiguzel, T. 22  
administrative tasks 22–24; fair use doctrine 203–204; potential of AI for 13–14  
agency of teachers 31  
Ahmad, S. 22  
AI Assessment Scale (AIAS) 256–258, **258–259**  
*AI Era Durable Skills Network* 336–340, 337, 339  
Akgun, S. 23, 108  
Akyuz, Y. 377  
algorithms: backpropagation 7; bias 181; black box, demystifying 106–107; development of 7  
A.L.I.C.E. 7–8  
alien minds, engagement with 84  
Alshehri, B. 31, 36  
Altarawnah, H. 32

Altman, S. 373, 374

Amara's Law 335

American Association of Colleges & Universities (AAC&U) 221

analysis and visualization of data 102–103

analysis of AI outputs 105

analytical skills, development of 97

Anderson, J. 372

Andressen, M. 79

animation, text-to- 69, 69–71, 70

anonymity, essays and 129

apprenticeship model 50

artificial general intelligence (AGI), development of 373–374

Artificial Intelligence Act 2024 (EU) 189–190

artificial intelligence (AI): evolution of 5–9, 121; pre-GenAI 4–5

assessment: AI Assessment Scale (AIAS) 256–258, **258–259**; alternatives to essays 133–138, 136; appropriateness to purpose 284–285; automating 299; challenge of 283, 284–286; context, understanding of 297; detection tools 292–293; of digital/data literacy and critical thinking 300; diversity and inclusion 285; education, purposes of 298–299; educators' continued involvement 298; enhancing with GenAI 294–298; ethics of AI and 300–301; formal examinations, move back to 291–292; future AI-powered 111, 298–301; human judgment in 107; in-person examinations 287; online exams 287; overall strategy for 294; peer 296; performance-based 289; portfolios 288; post-graduation, skills needed 294; purposes of 286; reliability and authenticity of 286–289, 294; rethinking 130–138, 136; review of, need for 283–284; self-assessment 288; standardized, frustration with 285; teacher-set and marked, reduction of 300; teaching about AI 227–228; technology, integration of into 286; types of, adjusting 299; what is assessed 285–286; *see also* essays assignments: examples of AI-augmented 274; reassessment of 264; repositories of 124

assistants, virtual 371–372

assistive AI tools 126–127

Atlas, 199

audio content generation by AI 166–167

audio-led learning: interactive dialogue 62–65, 63; language learning 64–65; podcasts 60–62

augmented reality (AR) 362, 363, 379

authenticity: assessment 286–289, 294; content 71–72; curriculum design 228–230

automated tasks 53

Azizah, A. 32

backpropagation algorithms 7

backwards design approach 225

Bainbridge, O. 198, 204

Baker, R.S. 318

balanced approach to AI 107–108, 155

Banh, L. 5

banter with AI to refine output 59

behaviorism 51

Bengio, Y. 5

Berendt, B. 35

bias: algorithmic bias 181; authenticity/accuracy of content 71–72; awareness of, education in 98–99; in content generation by AI 180–185, 183; data bias 181; debiasing 182–185, 183; as ethical concern about AI 10–11, 31, 144; fair use doctrine 196; future of AI 373; legislative policies 324–325;

literature review 22–23; minority groups 318–320; modal bias 181; prevention of via institutional policies 147–148, 153; social bias 181–182; technical 181

Black, P. 286

black box algorithms, demystifying 106–107

Blake, R.J. 237–238

bots. *see* chatbots

boundaries, physical, eradication of 381–384

Bowen, J.A. 268

Bozkurt, A. 20

bracelets, smart 368

brain-computer interfaces (BCIs) 370–371

brainstorming 105–106

branching scenarios 67–69, 68

Bridgeman, A. 227–228

brilliant.org 355

Bron, D. 376–377

Bruns, A. 372

Brunton, G. 25

Bucea-Manea-Toniş, R. 30

Cardon, P.W. 336–337, 338

Cardoso Ermel, A.P. 25

Carroll, C. 24, 25

Carter, M. 24, 35

Carucci, R. 90, 98

Cassidy, C. 292

catalog of approved AI tools 153

Caulfield, 199

Cellary, W. 20

Chan, C.K.Y. 200, 218

chatbots: as agents 85; creation of by students 80–81, 83–84; custom GPTs 85; enhancing assessment via 296–297; evolving definition of 85; faculty resources 86–88; generative AI 172; learning with 79–81; metabots 81–84; no-code chat, rise of 78–79; promotion of AI literacy via 82–84; as tutors 79–80

ChatGPT 9; adoption of AI, stages in 255–256; advances in 122; content creation 243–244; essays 122–123; improvements predicted 373; interactivity in self-directed lifelong learning 356; popularity, growth of 77, 121–122, 289–290; release of and concerns about 3–4, 289–291; safety measures 190–191; Usage Policies 190–191; use of for learning 32

cheating: academic integrity policies 125–127; academic writing 124–125; alternatives to essays 133–138, 136; assessment, rethinking 130–138, 136; assistive AI tools 126–127; attractiveness of AI 122; detection tools 11–12, 124; difficulty detecting in AI-produced writing 124–125; essays, vulnerability of 128–130; ethical use of AI tools 126–127; outsourcing essay writing 124; pandemic, impact of 287; plagiarism 124; propensity towards 127–128; *see also* ethics of AI

Chen, L. 22, 237, 238

Cheng, E.C.K. 237

Chiavaroli, N. 137

classroom activities, implementing AI tools in 273

clones of instructors 65–67, 66, 67; *see also* tutoring systems

clothing, smart 368–369

Coffey, 199

cognitive model 26

cognitive psychology 51

collaboration: AI-powered platforms for 102, 322; critical thinking skills and 94, 97; group AI projects 269; interdisciplinary, institutional policies and 149–150; learning outcomes 132; policy development 204; with students on AI usage guidelines 265

committees, AI 154

Common Core State Standards (CCSS) 51–52

communication skills: critical thinking skills and 97; learning outcomes 132; oral presentations 137; portfolios as alternative to essays 134; skills in the AI era 338–339, 339; students, preparation for AI 268–269

communities of practice 342–343

company policies. *see* institutional policies

competencies, shifting priorities for 336–340, 341

concerns about AI: ChatGPT 3–4, 9–10; detection tools 11–12; in education 9–12; ethical 10–11; over-reliance on AI tools 11; *see also* bias; data privacy and security; ethics of AI

connectivity disparities 314–315

constructivism 51

contact lenses, smart 369

content creation 54; audio 166–167; biased responses 180–185, 183; debiasing 182–185, 183; 3D models and animations 168–169; evaluation of AI output 176–177; factually wrong responses 173–177, 175; images 165–166; limitations of 173; logically wrong responses 178, 178–180, 179; misinformation and disinformation 185–187; multimodel experiences 169, 170; text 165; time lag between new and AI knowledge 173; tools for 243–245; video 167–168

contextualization of task for AI 56–57

continuous evaluation and improvement 151–152, 154

continuous learning, future of 381–384; *see also* lifelong learning

conversation with AI to refine output 59

convolutional neural networks (CNN) 8, 167, 168

Copilot 244

copyright. *see* fair use doctrine

Corbeil, J.R. 10–11

Corbeil, M.E. 10–11

cost of AI 108

Cotton, D.R.E. 10

Coursera 352–353

COVID-19 pandemic: cheating 287; digital divide 311

Crawford, J. 24, 221

Creative Commons (CC) 197–198

creativity: balancing AI with 107–108; promotion of 105–106

criteria for using AI, need for 19–20

critical reflection in teacher education 238

critical thinking: analytical skills, development of 97; assessment and 300; chatbots, creation of by students 83–84; collaboration and 94, 97; curiosity, cultivation of 97–98; definition 92–93; development of 13; education and 90–91; equitable access 108–109; evaluation of AI-generated information 98–99, 126; future directions 109–112; human touch, balancing with AI 107–108; importance of 90, 93–94; independent learners 93; informed decisions 93–94; integration of AI, strategies for 98–104; learning outcomes 131–132; lifelong learning 94; limited assessment of in essays 129; obstacles for AI 104–109; overreliance on AI 104–106; personalized instruction and learning 91–92; portfolios as alternative to essays 134; potential of AI for supporting 96–97;

project/inquiry-based learning 101–103; self-assessment/reflection 99–101; simulations 97, 103–104; simulations as alternative to essays 135, 136, 137; students, preparation for AI 266–268; syllabuses, revamping 131–132; topics, selection and presentation of 132; transparency, AI's lack of 106–107

cross-disciplinary collaboration: institutional policies and 149–150; integration of AI across disciplines 272–273

culture of the institution 154–155

Cummings, L. 83–84

curated research tasks 105

curiosity, cultivation of 97–98

curriculum design: authentic 228–230; backwards design approach 225; connections between subjects 223–224, 224; explicit/implicit practices 221–223, 225–226; human capabilities 229–230; impact of generative AI 220; industry partners 229; longer term perspective 222; mapping 224; role modeling by teachers 221; staff perceptions of generative AI 220; updating 228–229; vision for 223

custom GPTs 85

customized learning paths 53

DALL-E 1/DALL-E 2 9

data analysis and visualization 102–103

data bias 181

data ethics framework 27

data governance 153

data privacy and security: digital divide 313; as ethical concern about AI 11, 31, 32, 72, 145, 187–188; institutional policies 146, 153; literature review 22–23; mitigating risk 188–189

data used for training AIs 171–172

data visualization 137–138

Davis, F. 254

day in the life in the year 2040 363–365

debate on AI outputs 105

debiasing 182–185, 183

De Buyser, B. 320

decision-making: critical thinking skills and 93–94; data-driven parameters for 153

deep learning 8, 106

democratized education 40

depersonalization as concern over AI 144–145; *see also* personalized instruction and learning

description of courses 131

design fiction, use of to imagine the future of learning 365–366

detection tools 11–12, 124, 203, 288, 292–293

Dewey, J. 50, 90

dialogue, interactive, with AI 62–65

Diaz-Garcia, V. 30

diegetic prototypes 365

difficult topics, simulations and 135, 136, 137

Diffit.me 244–245

diffusion models 165, 166, 167

digital assistants 371–372, 382

digital divide: access to technology/internet/AI 108, 219–220, 310, 312–316; AI tools 322–323; assessment and 301; bridging, AI's role in 312–313, 320–323; connectivity disparities 314–315; COVID-19 pandemic 311; data privacy 313; defining 310–311; democratized education 40; digital literacy, gaps in 316–318; disabilities, student with 319–320, 322; future research, questions for 326; inequities in education, addressing 311–312; legislative frameworks 323–325; non-native

speakers, inclusion for 321; personalized learning 312–313, 321; preparation for college 310; skill development tools 322; widening of, AI's role in 312–320

digital learning, rise of 51–52

digital literacy 126; assessment and 300; gaps in 316–318

digital storytelling 137–138

disabilities, students with 319–320, 322, 379

discrimination: as ethical concern about AI 31, 72, 144; literature review 23; *see also* ethics of AI

disinformation: content generation by AI 185–187; factually wrong responses by AIs 173–177, 175; logically wrong responses by AIs 178, 178–180, 179

distance education 21

Dogan, M. 21

Donath, J. 371–372

Dr. Sbaitsos 7

driverless cars 7

Duckworth, A. 12–13

Duolingo 355

Dwivedi, Y.K. 197, 204–205, 220

early AI tools 236

Eaton, L. 270

Eaton, S.E. 216

Edith Cowan University, Australia 218, 218–219

Edmunds, D. 6

educators. *see* teachers

Einstein, A. 112

ELIZA 6

ELIZA Effect 6–7

emotional processing of changes 260–262

Ennis, R.H. 93

equity: of access 108–109; inequities in education, addressing 311–312; teaching about AI 219–220; of use 23; *see also* digital divide; ethics of AI

era of AI: adaptability as core competency 338, 341; characteristics of 333–335; communication skills in 338–339, 339; competencies, shifting priorities for 336–340; *Durable Skills Network* 336–340, 337, 339; leadership skills in 339, 339–340; strategies for educators 340–343; subject matter expertise, continued need for 338, 341; technical skills in 339, 340

errors in responses by AIs: factual 173–177, 175; logically wrong responses by AIs 178, 178–180, 179; *see also* misinformation

essay mills/banks 124

essays: alternatives to 133–138, 136; anonymity 129; cheating, ways of 124; critical thinking, limited assessment of 129; difficulty detecting cheating 124–125; impact of ChatGPT 122–123; importance given to 123; marking, stress of 130; predictability of 129; reliability and authenticity 288; structure of 129; subjectivity in evaluation of 129; vulnerability to cheating 128–130; *see also* assessment

ethics of AI 23, 31; assessment and 300–301; authenticity/accuracy of content 71–72; complexity of 32; data ethics framework 27; digital divide and 313; discrimination 23; education in 98–99; equity of use 23; evaluation of AI 38; evaluation of AI-generated information 98–99; existing framework 26; fair use doctrine 202–203, 204–205; framework for implementing AI 28, 31–32, 33, 35–36; future of AI 373; guidelines/principles 152; human interaction, reduction in as concern 72; institutional

policies 147; intellectual property rights 72; literature review 22–23; marginalized groups 318–320; over-reliance on AI tools 11; students, preparation for AI 270–271, 276; teaching about AI 217–219; transformative teaching 71–73; *see also* bias; cheating; data privacy and security

evaluation of AI: critical thinking skills, use of for 98–99, 126; Nested Framework for Implementing AI in Education 38–39; output of AI 59–60, 176–177, 186–187

evolution of artificial intelligence (AI) 5–9, 121

evolution of teaching methods 50–53

examinations 287

experimentation with AI 342

expert systems 6

explainable AI (XAI) for education 110–111

explicit/implicit practices in curriculum design 221–223, 225–226

fabrics, smart 368–369

fact-checking: of AI outputs 105; skills in 99

factually wrong responses by AIs 173–177, 175

fair use doctrine: administrative tasks 203–204; agreement about, development of 202–204; biases 196; Creative Commons (CC) 197–198; defined 195–196; ethics of AI 202–203, 204–205; in generative AI Domain 196; institutional policies and 199–200, 201; public domain 197; purpose of 196; research and 197; training of AI 196

feedback: accessibility and 149; automating 299; effectiveness of 72; goal setting, self-reflection through 100–101; growth mindset, fostering 100; human judgment in 107; personalized 99–100

Feedly 354

Ferrer, J. 203

Fifth Generation Computer project 7

Fleischmann, C. 336–337

Focuster 356

formal examinations, move back to 291–292

foundational understanding, teachers gaining 262–263

framework for use of AI in education: development of 25, 28–29, 29; Edith Cowan University, Australia 218, 218–219; ethical practice component 28, 31–32, 33, 35–36; evaluation of AI using 38–39; existing frameworks, identification of 25, 26–27, 28–29, 29; first iteration 29; framework synthesis method 24–25; future steps 40–41; implementation of 37–38; implications for use of 39–40; institutional culture and 154–155; institutional transformation 28, 29–31, 33, 34–35; macro/meso/micro levels 28, 33, 34–37; multilayered approach 25; need for 20; Nested Framework for Implementing AI in Education 33, 33–41; personalized instruction 28, 29, 32–33, 36–37

Furze, L. 256–258, 258–259

future of learning: adaptive learning platforms 378–380; artificial general intelligence (AGI), development of 373–374; assessment 111, 298–301; boundaries, physical, eradication of 381–384; brain-computer interface 370–371;

critical thinking/problem-solving skills 109–112; a day in the life, 2040 363–365; design fiction, use of to imagine 365–366; digital divide, research into 326; headsets, VR 369–370; intelligent tutoring systems (ITS) 377–378; personalized instruction and learning 363, 375–377; phygital learning environments 362, 366–372; predictions for AI in 2040 372–374; scenarios showing 376, 377–378, 379–380, 382–383; smart clothing 368–369; smart glasses and contacts 369; smart jewelry 367–368; smartphones 367; transformative teaching 73–74; use of AI 40–41; virtual assistants 371–372

Futurepedia 246

gamified learning experiences 95–96

Gamma 247

Gates, B. 373

Gawdat, M. 79

Gemini 244

generative adversarial networks (GANs) 8, 166, 167, 168

generative AI (GenAI), tasks possible through 5

George, B. 30

George, R. 371

Ghnemati, R. 27, 40

Gibson, W. 73

Gillmor, D. 290

glasses and contacts, smart 369

goal setting: and management 356–357; self-reflection through 100–101

goblin.tools 320

Goksel, N. 20

Gonzalez, V.H. 297

González-Calatayud, V. 21

Google LaMDA 9

Google Scholar 354

Google's Gemini 244

Gordon, M. 13

governmental policies, digital divide and 323–325

GPT-3 8–9

Graham, J. 365–366

Greenhow, C. 23, 108

grief cycle 254

growth mindset, fostering 100

Guerra, A. 22

guidance for student in using AI, need for 20

Habitica 356–357

Hager, P.J. 351

hallucinations 173–177, 175, 373

Harry, A. 33

Hashim, S. 32

Hasibuan, R. 32

Hawn, A. 318

headsets, VR 369–370

Henderson, E. 123

Herd, S. 372

Hick, D. 290, 292

higher education: AAI-HE model 27; transformation framework 27

Hinton, G. 7, 8, 374

historical figures, discussions with 53

history of artificial intelligence (AI) 5–9, 121

Holmes, W. 26

Hong, Y. 27

honor codes 203

Huang, H. 8

Huang, J. 336

human-AI partnership 111

human capabilities, curriculum design and 229–230

human interaction, reduction in as concern 72

human touch, balancing with AI 107–108, 155

Hyperwrite 85

images: DALL-E 1/DALL-E 2, generation by 9; generation of by AI 165–166

immersive learning 96, 362, 363, 379; critical thinking/problem-solving 109–110

implementation of AI. *see* framework for use of AI in education

implicit/explicit practices in curriculum design 221–223, 225–226

inaccurate content 71–72

inaccurate responses by AIs: factual 173–177, 175; logical 178, 178–180, 179

inclusivity: institutional policies 149; *see also* access to technology/internet/AI; bias; ethics of AI

independent learners: critical thinking and 93; *see also* self-directed learning

independent research skills 105

inequity. *see* digital divide; equity

infographics 137–138

informed decisions, critical thinking skills and 93–94

innovation, culture of 155

in-person examinations 287, 291–292

inquiry-based learning (IBL) 101–103

in-service teachers. *see* teacher education; teachers

institutional policies: accessibility 149; accountability 148, 153–154; bias prevention 147–148, 153; catalog of approved AI tools 153; ChatGPT Usage Policies 190–191; continuous evaluation and improvement 151–152, 154; culture of the institution and 154–155; data-driven decision-making parameters 153; data governance 153; data privacy and security 146, 153; development of 145–154; Edith Cowan University, Australia 218, 218–219; ethical considerations 147; ethical guidelines/principles 152; fair use doctrine and 199–200, 201; guidelines for use 153; inclusivity 149; interdisciplinary collaboration 149–150; legal compliance 146; objectives for AI 152; opportunities and challenges of AI 143–145; practical guidance for 152–154; professional development 150–151, 154; stakeholder engagement 152; transparency 148, 153–154; trends/predictions in AI 155–156; vetting/assessment of technology 153; *see also* academic integrity

institutional transformation 28, 29–31, 33, 34–35, 38–39

instructions given to AI 58–59

integrated systems 73–74

integration of AI: long-term implications 275; strategies for 264–265, 272–275

intellectual property rights 72

intelligent learning platform 27

intelligent tutoring systems (ITSs) 95, 353–354, 363, 377–378

interactive dialogue with AI 62–65

interactivity: self-directed lifelong learning 355–356; in teacher education 241–242

interdisciplinary collaboration: institutional policies and 149–150; integration of AI across disciplines 272–273

interdisciplinary thinking 265–266

interpersonal skills, development of 72

Jantakun, T. 27

Japan, Wabot-2 7

Jauhainen, J. 22

jewelry, smart 367–368

Jian, M. 32

Jiao, P. 238  
 job displacement/security as concern 145  
 job platforms, AI-powered 322  
 Jones, N. 319

Kadaruddin, K. 22  
 Kahoot! 355–356  
 Kairinos, N. 381  
 Karjian, R. 8  
 Khan, S. 79, 353  
 Khanmigo 79, 80, 353  
 Klein, A. 9–10  
 Klopov, I. 26, 28  
 knowledge acquisition by AIs 169, 171, 171–173  
 Knowles, M. 349  
 Kohnke, L. 237  
 Kramm, N. 145  
*Kübler-Ross Change Curve Model* 254, 255, 260, 261, 262, 263, 264, 265, 266, 268, 270, 271, 272

LaMDA 9  
 languages: learning 64–65; non-native speakers, inclusion for 321; translation, statistical approach to 7; translation of AI-generated content 292  
 large language models (LLMs) 165, 172, 173–174  
 Latman, A. 195–196  
 Le, D.B.Q. 104, 111  
 leaders and administrators, AI and 23–24  
 leadership skills in AI era 339, 339–340  
 learning objectives: evaluation of 264; personalized 100–101  
 learning outcomes: critical thinking 131–132; focus on 126; teaching about AI 226–227  
 legal compliance, institutional policies for 146  
 legal framework: Artificial Intelligence Act 2024 189–190; digital divide and 323–325

Li, B. 351  
 Li, C. 8  
 library skills 105  
 licensed data 172  
 lifelong learning: AI's role in supporting 351–357; boundaries, physical, eradication of 381–384; desire for, creating 271–272; embracing 94; goal setting and management 356–357; increasing relevance of 350; interactivity 355–356; personalized instruction and learning 351–354; synergy with self-directed learning 350–351; for teachers 350–351

Lin, P.K. 196  
 Lin, Y. 20  
 literacy in AI: defined 237; promotion of via chatbots 82–84; students and educators 317–318; in teacher education 237–243

literature review: assessments and teaching 21–22; ethics of AI 22–23; leaders and administrators, AI and 23–24

Liu, D. 227–228  
 Loew, L. 383  
 logically wrong responses by AIs 178, 178–180, 179  
 London, M. 350  
 Long, D. 237  
 long short-term memory (LSTM) units 165, 167

machine learning 6, 7  
 Magerko, B. 237  
 Magicschool.ai 246  
 mapping, curriculum 224  
 marginalized groups 318–320, 322, 379  
 Marikyan, D. 261  
 Martinez, M.E. 93  
 McCarthy, J. 121  
 McCulloch, W. 7

McKenna, S. 145  
 meta-bots 81–84  
 metacognitive development 110  
 metaverse 96, 109–110  
 methods of teaching, *see* teaching methods  
 Microsoft's Copilot 244  
 Mills, 199  
 minority groups 318–320, 322, 379  
 Minsky, M. 6  
 misinformation 71–72; content generation by AI 185–187; factually wrong responses by AIs 173–177, 175; future of AI 373; logically wrong responses by AIs 178, 178–180, 179  
 modal bias 181  
 Mollick, E. 84, 335, 353  
 monitorial system 50  
 Moorhouse, B.L. 237  
 Morris, T.H. 349  
 Müller, 204  
 multilingual learners, adaptive learning platforms and 379  
 multimodel experiences 169, 170  
 Murray, M.D. 198–199  
 Murtarellia, G. 297  
 Musk, E. 370, 374  
 Mylessonpal 246–247  
 myths about AI, dispelling 237–238

natural language processing (NLP): A.L.I.C.E. 7–8; education applications 95; ELIZA 6; GPT-3 8–9; transformer architecture 8

Negoită, D. 31  
 Nested Framework for Implementing AI in Education 33, 33–41  
 neural networks 7, 8; convolutional neural networks (CNN) 8; modal bias in 181; recurrent neural networks (RNNs) 165  
 neural style transfer (NST) networks 166

neurodiverse learners, adaptive learning platforms and 379  
 no-code chat, rise of 78–79  
 non-native speakers, inclusion for 321

objectives for AI 152  
 Oh, S. 23  
 Okello, H.T.I. 20  
 Olorundare, K. 372  
 online exams 287  
 online learning 21  
 opacity of AI systems 205; *see also* transparency  
 OpenAI: ChatGPT 3–4, 9; DALL-E 1 9; Sora 70–71  
 open-book examinations 287  
 open-ended questions 106  
 open-ended research tasks 105  
 open-ended thinking, promotion of 105–106  
 open-source AI tools 108  
 operant conditioning 51  
 Oppenheimer, D. 4  
 oral presentations 137  
 organizational culture 154–155  
 Ouyang, F. 238  
 overreliance on AI, strategies to address 104–106  
 over-reliance on AI tools 11  
 Owan, V. 20

pandemic. *see* COVID-19 pandemic  
 Papagiannidis, S. 261  
 partnership, human-AI 54, 111  
 Pearce, J. 137  
 pedagogy, innovation in through AI 39  
 peer assessment 296  
 performance-based assessment 289  
 Perplexity.ai 244  
 personal assistants, AI-powered 371–372, 382  
 personalized instruction and learning 13, 22, 26, 132; adaptive

learning 53; AI as partner with teachers 54; audio-led 60–65, 63; automated tasks 53; benefits of AI 39; content creation 54; critical thinking skills 91–92; customized learning paths 53; democratized education 40; digital divide 312–313, 321; feedback 99–100; framework for implementing AI 28, 29, 32–33, 33, 36–37; future of learning 363, 375–377; interactive dialogue with AI 62–65; language learning 64–65; learning objectives 100–101; podcasts 60–62; self-directed lifelong learning 351–354; tailoring to students strengths and interests 375–377; text-led 54–60; transformative teaching 53–60; video-led 65–71, 66, 67, 68, 69, 70; virtual tutors 53

Pham, S.T.H. 236

phygital learning environments 362, 366–372

Piaget, J. 51

Pitts, W. 7

plagiarism 124, 126, 199–200

Plutarch 90

podcasts 60–62

policies. *see* academic integrity; institutional policies

Popescu, M. 31

portfolios 134–135, 288

post-graduation, skills needed 259, 275, 294; *see also* workplace, AI in

potential of AI: administrative tasks 13–14; in education 12–14; personalization of education 13

Prather, J. 23

predictability of essays 129

preparation for college, digital divide and 310

presentations 137

pre-service teachers. *see* teacher education

Press, G. 7

privacy: digital divide 313; as ethical concern about AI 11, 31, 32, 72, 145, 187–188; institutional policies 146, 153; literature review 22–23; mitigating risk 188–189

problem-solving skills: adaptation in a changing world 94; analytical skills, development of 97; collaboration and 97; curiosity, cultivation of 97–98; definition 93; education and 90–91; equitable access 108–109; evaluation of AI-generated information 98–99; future directions 109–112; human touch, balancing with AI 107–108; importance of 90, 93–94; integration of AI, strategies for 98–104; limited assessment of in essays 129; obstacles for AI 104–109; overreliance on AI 104–106; personalized instruction and learning 91–92; potential of AI for supporting 96–97; project/inquiry-based learning 101–103; simulations 97, 103–104; syllabuses, revamping 131–132; topics, selection and presentation of 132; transparency, AI's lack of 106–107

professional development: institutional policies and 150–151, 154; legislative policies for 325; for teachers 108–109; *see also* teacher education

professional use of AI 333–334

progressive education 50–51

project-based learning (PBL) 101–103, 106

prompting 5; clarity and directness in 185; SCRIBE method 54–60

public domain, fair use doctrine and 197

purposes of education 298–299

quality assurance: concerns about 215–216; educative approach to 216–217

questioning, cultivation of 97–98

Rainie, L. 372

Rawashdeh, S. 106

recurrent neural networks (RNNs)  
165, 168

Reich, J. 319

reliability of assessment 286–289,  
294

reliance on AI tools 11

remote learning, COVID-19  
pandemic and 311

research, fair use doctrine and 197

ResearchGate 354

research skills, independent 105

research tools, AI-powered 101

reskilling of staff 150–151

responsibility, assigning to AI 57–58

Rho, E. 382

rings, smart 368

Rogers, C. 348–349

role plays as alternative to essays  
135, 136, 137

role taken by AI, specifying 55–56

Rosenbaum, J. 55

Rowland, D.R. 200

Rumelhart, D. 7

rural/urban areas, connectivity  
disparities and 314

Rutnik, M. 367

Sabzalieva, E. 237

safety measures: in AI training  
172–173; ChatGPT 190–191

Sag, M. 198

Samberg, R. 197, 198

Sampson, P.M. 236

Samuel, A. 6, 121

Saylam, S. 31

*Schitt's Creek* (TV show) 253, 255

SCRIBE method of prompting  
54–60

self-assessment/reflection 99–101,  
134, 288

self-directed learning: advantages of  
348, 349; AI's role in supporting  
351–357; boundaries, physical,  
eradication of 381–384; defined  
348; evolution of 348–349;  
goal setting and management  
356–357; interactivity 355–356;  
as multidimensional concept  
349; personalized instruction and  
learning 351–354; synergy with  
lifelong learning 350–351; for  
teachers 350–351

Shannon, C. 6

Sharples, M. 123

Sheese, B. 216

Shrungare, J. 20

simulations: as alternative to essays  
135, 136, 137; critical thinking/  
problem-solving skills 95–96, 97,  
103–104

skill development tools 322

Skinner, B.F. 51

smart clothing 368–369

smart glasses and contacts 369

smart jewelry 367–368

smartphones, future 367

Smith, P. 372–373

Snow, N. 196

social bias 181–182

social-emotional learning (SEL) 108,  
110

socio-economic factors: bias in AI  
systems and 318–319; connectivity  
disparities and 314–315

Sora 70–71

sound content generation by AI  
166–167

source evaluation skills 99, 105

Southworth, J. 337, 340

staff perceptions of generative AI 220

stakeholder engagement 152

STEP framework 341–342

Sterling, B. 365

Stim, R. 196

Strobel, G. 5

structured approach to using AI in  
learning 341–342

structure of essays 129

student-centered learning, move  
from teacher-centered 50–51

student relationships 264

students, preparation for AI: adaptability 271–272; AI Assessment Scale (AIAS) 256–258, **258–259**; collaborative AI projects 269; communication skills 268–269; critical thinking development 266–268; ethical implications of AI 270–271, 276; foundational understanding, gaining 262–263; hands-on experience 263–264; integration of AI across disciplines 272–273; interdisciplinary thinking 265–266; lifelong learning 271–272; long-term implications 275; post-graduation, skills needed 259, 275; variety of AI tools 260; writing workshops, AI-assisted 269

subject matter expertise, continued need for 338, 341

syllabuses, revamping 131–132

Tannenbaum, R. 82–83

Tapalova, O. **26**, 28

teacher-centered learning, shift to student-centered 50–51

teacher education: AI tools and software 243–247; comfort level with AI, evaluation of 256–258, **258–259**; content/text, tools for 243–245; critical reflection 238; integration of AI literacy in 237–243; interactivity 241–242; learning needs of teachers 240–241; medium used for 241; myths about AI, dispelling 237–238; position of AI in teaching, paradigms of 238; productivity, tools for 246–247; from simplicity to complexity 242–243; tips for optimizing 247–248; visual content tools 245–246

teachers: adoption of AI, stages in 253–256; agency of 31; AI literacy 317; continued involvement in assessment 298; emotional processing of changes 260–262; familiarity with AI tools 237; interdisciplinary thinking 265–266; perceptions of generative AI 220; personal AI use, demonstration of 264; professional development for 108–109, 150–151; role modeling by 221; self-directed lifelong learning for 350–351; strategies for in era of AI 340–343; *see also* teacher education

teaching about AI: assessment 227–228; background knowledge probe 225; backwards design approach 225; connections between subjects 223–224, **224**; curriculum design 220–230; diversity of students 214; equity and access 219–220; ethical concerns 217–219; explicit/implicit practices in curriculum design 221–223, 225–226; human capabilities 229–230; industry partners 229; learning outcomes 226–227; need for 180, 189, 214; quality assurance, educative approach to 216–217; role modeling by teachers 221

teaching methods: evolution of 50–53; technology, rise of 51–52

teamwork, critical thinking skills and 97

technical bias 181

technical skills in AI era 339, 340

technological disparities between institutions 72–73

*Technology Acceptance Model (TAM)* 254–255, 260, 261, 262, 263–264, 265, 266, 268, 270, 271, 272

technology in education, rise of 51–52

text-led learning: discussion via 54–55; prompting methods 54–60; tools for 243–245

text-to-animation/video 69, 69–71, 70

text-to-speech AI 61

textual content, generation of by AI 165

Thongprasit, J. 27

3D models and animations 168–169

time lag between new and AI knowledge 173

Timmis, 133

T.J. Watson Research Center 7

Tlili, A. 23

topics, selection and presentation of 132

Tough, A. 349

training and development for teachers. *see* professional development; teacher education

training of AI 169, 171, 171–173; fair use doctrine 196

transformative teaching: audio-led learning 60–65, 63; ethical concerns 71–73; evolution of teaching methods 50–53; future trends and possibilities 73–74; integrated systems 73–74; personalized learning 53–60; text-led learning 54–60; video-led learning 65–71, 66, 67, 68, 69, 70

transformer architecture 8, 167, 181

translation of AI-generated content 292

transparency: AI's lack of 106–107; in AI use 126; debiasing and 184–185; education in 98–99; explainable AI (XAI) for education 110–111; institutional policies 148, 153–154

Trello 356

Turing, A. 6, 121

Turing Test 6

Turnitin 11–12, 127, 288

tutoring systems 65–67, 66, 67, 353–354, 363, 377–378

twins of instructors 65–67, 66, 67; *see also* tutoring systems

two-lane approach for assessing generative AI 227–228

Tyrangiel, J. 79

UNESCO *Ethics of artificial intelligence* 218

Unger, L. 12–13

urban/rural areas, connectivity disparities and 314

Valentini, A. 237

variational autoencoders (VAEs) 166, 167

vetting/assessment of technology 153

video, text-to- 69, 69–71, 70

video content generation by AI 167–168

video-led learning: branching scenarios 67–69, 68; clones of instructors 65–67, 66, 67; text-to-animation/video 69, 69–71, 70

virtual assistants 371–372, 382

virtual collaboration platforms 102

virtual reality (VR) 362, 363, 369–370, 379

virtual spaces 96

virtual tutors 53, 95

vision, computer 8

vision for curriculum design 223

visual content generation by AI 165–166; tools for 245–246

visualization of data 102–103, 137–138

voice cloning 61

Vygotsky, L.S. 352

Wabot-2, Japan 7  
Walczak, K. 20  
Wang, T. 237  
Wannapiroon, P. 27  
Watson, C.E. 268  
wearable technologies 367–369  
Weissman, J. 10  
Weizenbaum, J. 6  
“What If” scenarios 105–106  
White, D.L. 24, 35  
William, D. 286  
Williams, R. 7  
Williams, S. 12, 371  
Wooden, O. 30  
workplace, AI in: access to AI 333; adaptability as core competency 338, 341; changes in desired skills 335; communication skills 338–339, 339; competencies, shifting priorities for 336–340; humanlike abilities 335; integration into productivity 334–335; leadership skills in 339, 339–340; performance and capabilities of AI tools 334; professional use of AI 333–334; strategies for educators 340–343; subject matter expertise, continued need for 338, 341; technical skills in 339, 340  
writing workshops, AI-assisted 269  
wrong responses by AIs: factual 173–177, 175; logical 178, 178–180, 179  
Yan, L. 217  
YouTube 353–354  
Yu, D. 317  
yy 354  
Zafari, M. 22  
Zewe, A. 5–6  
Zhai, C. 11  
Zhao, Y. 375  
Zone of Proximal Development 64, 352