

EMERGING TRENDS IN
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Instructional Design in E-Learning

Principles, Trends, and Opportunities

Edited by Soufiane Ouariach,
Fatima Zahra Ouariach, Inam Ullah Khan,
Firyal Latrache, Najwa Jbira,
and Veerpratap Meena



Instructional Design in E-Learning

This comprehensive guide examines the restructuring of instructional design principles and practices for digital learning environments. It combines established pedagogical principles with the latest technological innovations to help practitioners create effective, learner-centered online experiences.

The volume grounds its recommendations in foundational instructional design models, including ADDIE, TPACK, and the Community of Inquiry framework, to demonstrate how these approaches are being reconfigured for digital transformation. It explores multimedia learning design through Cognitive Load Theory, Dual Coding Theory, and Mayer's Cognitive Theory of Multimedia Learning, offering guidance on optimizing the integration of text, images, audio, video, and interactive elements. The text presents architectural frameworks for flipped classrooms using Small Private Online Courses and examines the integration of synchronous and asynchronous modalities in blended higher education. Accessibility is addressed through Universal Design for Learning and Web Content Accessibility Guidelines implementation strategies, while emotional design principles illustrate the creation of meaningful learner-content connections. The volume explores emerging technologies, including GenAI integration within learning management systems for personalized feedback and intelligent tutoring, AI-driven adaptive learning systems, and virtual reality and augmented reality applications that foster embodied cognition and situated learning across disciplines, from medical education to historical reconstruction.

This collection is designed for instructional designers, educational technologists, and faculty members seeking evidence-based strategies for digital course development. It will help graduate students, curriculum developers, and policymakers in promoting equitable access to quality online education.

Emerging Trends in Science, Innovation and Business

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To my parents, whose steadfast support and guidance have shaped the course of my life.

To my brother and sister, whose encouragement has always strengthened my resolve.

With special gratitude to Dr. Inam Ullah Khan for his invaluable assistance, dedicated support, and unwavering generosity. His presence has been that of a brother, and I remain deeply indebted.

Soufiane Ouariach

I dedicate this work to my beloved parents, whose unwavering support, commitment, and sacrifices have always been my primary source of strength and motivation.

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Inam Ullah Khan

I dedicate this book to those who taught me or contributed to my education: Papa Farid Latrache for teaching me mathematics and science, Mama Fatima Hamdaoui for teaching me the French language, my brother Mohammed Latrache

for tutoring me in chess and mathematics, my aunt Halima Hamdaoui (may her soul rest in peace) for helping me write my name in Latin letters, and my aunt Najat Latrache for teaching me the Arabic language.

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Firyal Latrache

I dedicate this book to my parents, whose love has been the foundation of everything I have achieved.

To my brothers and sisters, who supported me tirelessly both morally and financially through every stage of this journey.

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Najwa Jbira

I express my heartfelt gratitude to my family, who have been the greatest pillars of strength in my life. I dedicate this work to my beloved grandmother Smt. Sarupi Devi and my mother Smt. Barfi Devi, whose unconditional support, blessings, and constant encouragement have always inspired me to move forward with confidence. I remain forever indebted to my grandfather Shri Ramnath Meena and my father Shri Kamal Phool Meena, who raised me to be fearless and independent and provided every possible comfort and opportunity to help me achieve my dreams.

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Veerpratap Meena

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Preface

Education has changed significantly over the past ten years. Previously viewed as secondary or optional, online learning, digital assessment, and virtual collaboration now form the core of the way we imagine, design, and realize educational experiences. This transition has put instructional design at the center of modern pedagogy, requiring practitioners, researchers, and educators to rethink all established approaches and realize new possibilities.

Instructional Design in E-Learning: Principles, Trends, and Opportunities can be explained by the fact that successful e-learning requires more than merely attempting to import classroom practices into the online environment. It necessitates a radical rethink of the way we interact with learners, the way we organize knowledge, the way we evaluate comprehension, and the way we use technology to make the educational process meaningful. This book provides a compilation of the existing studies, theories, and useful plans to address this challenge.

This book is structured into interrelated dimensions that collectively determine excellence in digital instructional design. It starts by examining how foundational models, such as ADDIE, TPACK, Universal Design for Learning, and the Community of Inquiry framework, are being modified and expanded for online environments. Then, the book catalogs the cognitive science behind efficient multimedia design based on Cognitive Load Theory, Dual Coding Theory, and Mayer's principles, which can be used to make decisions regarding how text, images, audio, video, and interactive components can be synthesized to maximize learning.

In these chapters, this book has a dual focus on established principles and innovation. Blended learning environments with the integration of synchronous and asynchronous modalities are given significant attention, as well as the architectural design of the flipped classroom using Small Private Online Courses. It also addresses the substantial need for accessibility and inclusion, with specific guidelines for applying Universal Design for Learning and Web Content Accessibility.

This book also looks at the technologies that are changing what is possible in instructional design. It examines artificial intelligence (AI), generative AI tools, adaptive learning systems, and immersive technologies, including virtual reality and augmented reality. These technologies are not merely viewed as new tools but also viewed as powerful instruments that, when used carefully, can personalize learning pathways, provide intelligent feedback, and create learning experiences that utilize the body. We are excited about the potential of these technologies, but we also understand the challenges they present. These challenges include costs, technical problems, and questions of fairness, privacy, and how well they work in classroom settings.

This book is based on our commitment to realistic and sustainable strategies. We understand that the way people get involved in design processes is not always the

same as what is possible in real life. Instead of suggesting impossible goals, it gives practical advice that can be used in learning management systems and institutional settings that are already in place, while still encouraging digital education to be as inclusive as possible.

We are grounded in realistic and sustainable strategies. We know that the manner in which individuals engage in design processes does not necessarily match what can take place in the real world. We do not propose unrealistic aims but rather offer targeted recommendations that can be applied to existing learning management systems and institutional contexts, while still promoting the fact that digital learning should be as inclusive as possible.

Without the efforts of researchers and practitioners working at the intersection of instructional design, educational technology, and the learning sciences, this book would not have been possible. Their collective wisdom informs all of the chapters.

We invite readers to engage with this book as an invitation to an ongoing discussion about how we can create learning experiences that are pedagogically, technologically, and truly inclusive. The prospects ahead of us are vast, and so is our responsibility to ensure that we gradually achieve them.

Acknowledgments

The completion of this volume represents the culmination of collaborative effort and scholarly dedication. We would like to thank everyone who helped us make this work a reality.

To start with, we would like to express our gratitude to the contributing authors whose knowledge, studies, and dedication to the advancement of digital instructional design are the essence of this book. They have been willing to share their knowledge, to undergo a stringent peer review, and to revise their work on several occasions; therefore, this has resulted in a collection that we are confident contributes richly to the discipline.

To the reviewers, we owe a huge debt, and we are grateful that they found the time and skills to appraise the chapters in this book. Their positive reviews, incisive comments, and thoughtful recommendations strengthened all the sections of this book. The high quality of this work is a manifestation of their focus on academic excellence.

Special thanks are due to our publisher for their confidence in this project and their patience as it developed. The editorial staff provided their priceless advice, business acumen, and consistent support from the first proposal all the way to the finished product.

We also want to acknowledge the larger community of instructional designers, educational technologists, and learning experience designers whose daily work in delivering effective digital learning environments provides the purpose and urgency for academic work such as this. They are the very people for whom this book is written and because of whom it exists.

Lastly, we would like to say that we greatly appreciate our families, whose patience and support mean everything to us. They are the ones who keep us going in whatever we do professionally.

About the Editors

Soufiane Ouariach holds a doctorate in Computer Science and University Pedagogical Engineering. His scholarly work centers on innovative instructional approaches, with a particular focus on flipped classroom models supported by SPOCs (Small Private Online Courses), as well as the design and implementation of distance learning environments. His research contributes to advancing pedagogical methodologies within the broader field of educational technology, with the aim of redefining effective, learner-centered digital education. He has served as a reviewer for internationally recognized publishing houses and international conferences. His academic expertise extends into instructional design for online and blended learning systems, where he remains committed to exploring forward-looking trends, emerging technologies, and opportunities that can drive meaningful innovation in the e-learning landscape.

Fatima Zahra Ouariach holds a doctorate in Communication and Educational Technology and serves as a temporary professor at Abdelmalek Essaadi University. Her research focuses on managing communication tools in e-learning through an LMS platform, with the aim of designing an efficient communication architecture for online learning environments. In addition to her research activities, she serves as an associate editor, editor, and reviewer for reputed publishing houses. She has participated in numerous international conferences and has served as a jury member for oral interviews at her university, demonstrating her strong commitment to research, education, and academic service.

Inam Ullah Khan is a distinguished academic, industry professional, and technological pioneer whose expertise in artificial intelligence (AI), artificial general intelligence (AGI), machine learning, deep learning, and evolutionary computing drives innovation across critical fields like cryptography, unmanned aerial vehicles (UAVs), routing protocols, and intrusion detection systems (IDS). As the Founder of AI-Explain Your Science (AI-EYS), he currently spearheads three major AI and AGI projects. He earned his PhD in Electronics Engineering from Isra University, Islamabad, and he has research experience as a visiting researcher at King's College London, UK. He holds a postdoctoral research fellowship at Multimedia University, Malaysia, and he serves as a research fellow in AI and cybersecurity at the National Cyber Emergency Response Team of Pakistan. He is currently serving as an assistant professor and head of the Business Incubation Center at Fazaia Bilquis College of Education for Women, Rawalpindi.

He is a senior member of IEEE and a global mentor and guest lecturer at IE University, Madrid, Spain. In addition, he serves as an adjunct professor at Lincoln University College, Malaysia, and PSGR Krishnammal College for Women, India.

In the past, he has collaborated with the HEC, the British Council, and leading universities to develop the National Curriculum for AI for Cybersecurity courses at the master's and PhD levels. Furthermore, he developed five national-level curricula on FinTech, including AI for Banking, AI for Financial Institutions, Power BI, SAGE, and TALLY, which have been operational in Pakistan for the past two years. He has also served as a Trainer at NAVTTC and as an Advisor for Cisco Community Pakistan.

He has authored or co-authored over 120 articles and has served in editorial roles for approximately 30+ books. His books have been formally recognized by an Ivy League institution, with five of his books officially cataloged in the esteemed Yale University Library. He is also a recognized innovator, holding a UK design patent for an agricultural drone for crop health monitoring, an Indian patent for a digital pen, and a UK design patent for a solar-powered nutrient tracking device in greywater systems. He serves as General Chair for multiple international conferences, including ICTIST, ICAI, and ICETI. He is frequently featured as a technology expert on Pakistani national and international television, further solidifying his role as a leading voice in emerging technologies and national policy.

Firyal Latrache holds a doctorate in Mechanics and Energy Engineering, with a special emphasis on the mathematical modeling of energy systems and energy efficiency in buildings. She currently serves as an adjunct professor at Mohammed First University, Oujda, Morocco, where she delivers courses on thermodynamics, underground hydraulics, and automotive technologies. Her research contributions focus mainly on the deployment of the sustainable development goals (SDGs) and the implementation of energy transition policies by introducing innovative approaches and green mathematical models. She recently published an edited book that explores the operationalization of an innovative energy transition using sustainable digital technologies, with the aim of decarbonizing the planet by 2050. She has reviewed several research works and has participated in the organization of international conferences on green education and the environment.

Najwa Jbira holds a doctorate in Energetics and Energy Efficiency, with a special emphasis on the optimization of energy use within industrial systems. Her research centers on two key optimization approaches widely applied in industrial engineering: Pinch analysis and Exergy analysis. She has explored these methods extensively, particularly within the dairy sector, where energy integration and process optimization play a critical role in reducing energy consumption and improving sustainability. Throughout her academic career, she has reviewed numerous scientific papers for conferences and journals and has organized several doctoral workshops and scientific events, contributing to the advancement of knowledge in energy systems and industrial optimization. She also serves at the Ministry of the Interior on renewable energy projects and supports initiatives aimed at enhancing environmental sustainability and energy transition efforts across the region.

Veerpratap Meena is an assistant professor in the Department of Electrical Engineering at the National Institute of Technology (NIT), Jamshedpur, India. He received his BTech

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He has been actively involved in IEEE and currently serves as the Chair of the IEEE Systems Council Systems Education Technical Committee, USA (since 2023). He was also appointed as Chair of the Student Chapter Educational Program (SCEP) Subcommittee for the term 2025–2027. In addition, he holds leadership positions in the IEEE Delhi Section and Rajasthan Subsection, including Chair of the IEEE Delhi Section–Rajasthan Aerospace and Electronic Systems Society Chapter and the IEEE Systems Council Joint Section Chapter. He is also the Founder and General Chair of two international IEEE conference series: IEEE ICE2CPT and IEEE AIEI.

His research interests include microgrids, renewable energy, power electronics, optimization, artificial intelligence, machine learning, smart grids, net-zero energy grids, electric vehicles, control systems, peer-to-peer energy trading, and healthcare applications. He has published more than 125 international research papers, one book, and one patent, and he has contributed extensively to reputed journals and conference proceedings. He serves as an associate editor for several reputed journals. In 2024 and 2025, he was listed among the World's Top 2% Scientists by Stanford University and Elsevier for his impactful research contributions.

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A Note from the Lead Editor

It is an honor and a pleasure to introduce the book *Instructional Design in E-Learning: Principles, Trends, and Opportunities*. This volume arrives at a time when the questions it addresses are more pressing than ever, and the opportunities it explores are highly consequential for the future of education.

Online and blended learning have become integral to educational practice, from primary schools to doctoral programs and from corporate training to lifelong learning initiatives. The COVID-19 pandemic accelerated this transformation dramatically, but the underlying trend was already well established. We now live in an era in which the quality of instructional design directly influences the quality of education for millions of learners worldwide.

This shift has profound implications for researchers and practitioners of instructional design. The principles developed over decades of research—from behaviorist foundations through cognitivist advances to constructivist and connectivist frameworks—remain essential. Yet, they must be reassessed, extended, and sometimes reimaged for contexts that earlier theorists could hardly have anticipated. How do we apply what we know about cognitive load when learners engage with immersive virtual reality environments? How do we design for meaningful social presence when interaction occurs asynchronously across time zones and cultures? How do we maintain academic integrity when artificial intelligence can generate sophisticated content instantly? These are not merely technical questions; they are fundamentally pedagogical ones that require careful consideration of what learning is, how it occurs, and what purposes it serves.

The difference between this volume and the previous ones is that it attempts to answer such questions with scholarly rigor and practical wisdom. The contributors and editors have done a thorough treatment that skillfully switches between the theoretical basis and implementation plan, and between proven principles and new ideas. The critical examinations of cognitive theories presented here are considered to guide the successful development of multimedia design, as well as provide specific advice on how to integrate generative AI into learning management systems. Readers will be exposed to a systematic literature review of the research on blended learning, as well as case studies reflecting the way virtual and augmented reality technologies can contribute to learning in particular disciplines. The focus is kept throughout on what actually works and not on technology as an end in itself, but on technology that serves the cause of learning.

We are especially happy to notice how accessibility and inclusion are touched upon throughout this volume. Due to the growth of digital learning, there has been an increased role on our part to ensure that it is equitable for learners. The discourses on

Universal Design for Learning, Web Content Accessibility Guidelines, and AI-driven assistive technologies show an advanced perception that the quality and success of instructional design cannot be disentangled from a dedication to educational justice. A design of the learning experience that is the most beautiful will be of no value when large groups of learners do not have access to it or cannot use it successfully.

The authors of this book are a mixed group of researchers and practitioners who share their commitment to the idea of how individuals learn in the digital world and how we can create an experience that facilitates that learning. They base their work on the achievements of previous generations and move in a new direction. This is exactly what our discipline needs, a respect for established knowledge and a readiness to innovate.

This book is recommended to instructional designers who want to improve their practice, to researchers who seek new problems in the area of educational technology, to faculty members who need to cope with the challenges of online and blended instruction, and to graduate students who are just starting their careers in this vibrant field.

Education has always been about equipping individuals to pursue thousands of futures, which we cannot really foresee. Instructional design is an essential field for achieving that purpose in our present-day times. This book is better equipped to help accomplish this more intelligently and more efficiently.