

AI-Integrated Instructional Design in Higher Education: A Systematic Exploration of Tools, Roles, and Challenges

[Yufeng Qian](#)

Louisiana State University

[Ragia Hassan](#)

Indiana University of Pennsylvania

Over the past few decades, technology-enhanced learning has positioned instructional design as a crucial catalyst for academic innovation within higher education. The emergence and rapid integration of artificial intelligence (AI) are now reshaping instructional design practices. This review study reveals a rapidly expanding ecosystem of AI tools that extend instructional design's content generation, creativity, and analytics aspects. Yet, while AI enhances efficiency and scalability, this review also identifies growing concerns over the erosion of design intentionality, learner-centeredness, and pedagogical depth in the pursuit of automation. Importantly, this study argues that AI is no longer merely a supplementary, augmenting tool, but is becoming an embedded and cocreative partner within modern instructional design practice – signaling a paradigm shift from tool use to design partnership in the AI era. As AI reshapes higher education, instructional designers must exercise technology leadership – ethically steering rapid change and orchestrating evidence-based teaching, learning, and assessment.

Instructional design has emerged as a critical catalyst for digital transformation and academic innovation in higher education, shaping how teaching and learning evolve (Bates, 2019; Online Learning Consortium, 2023). Concurrently, the rapid advancement of artificial intelligence (AI) offers unprecedented opportunities to magnify instructional design's influence on learning experience, educational quality, and accessibility (Brandon, 2024; Gibson, 2023).

Historically, instructional design and technology have maintained an intertwined relationship characterized by mutual evolution. Instructional models and learning theories have consistently adapted in response to emerging technological advancements, ranging from early behaviorist-driven military training programs during WWII (Skinner, 1958) to current constructivist- or connectivist-inspired digital learning environments (Jonassen, 1991; Merrill, 2002; Siemens, 2004). This systematic review explores the current landscape of AI-powered instructional design in higher education, examining how AI is being integrated into instructional design practices and accelerating instructional designers' technology leadership role in driving academic innovation.

Background

Instructional design is widely defined as a systematic process of developing instructional specifications using learning and instructional theory to ensure the quality of instruction (Dick et al., 2005). It emerged formally during World War II, driven by the military's urgent need to efficiently train soldiers. Early instructional practices were deeply influenced by behaviorist theories, emphasizing measurable objectives, repetition, and reinforcement through immediate feedback (Skinner, 1958).

In the subsequent decades, cognitivist theories reshaped the field by focusing on internal mental processes. Robert Gagné's (1965) *Nine Events of Instruction* and the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model exemplified this cognitive shift, providing systematic frameworks aligning instructional methods with cognitive processes (Reiser, 2001). Later, during the 1980s and 1990s, constructivist theories further advanced instructional design by promoting learner-centered approaches that emphasized active knowledge construction, collaborative learning, and engagement with authentic tasks. These approaches were increasingly supported by emerging digital technologies, such as computer-based training systems, multimedia CD-ROMs, and the first internet-based e-learning platforms (Jonassen, 1991; Merrill, 2002).

Starting in 2015, data analytics started to play a role. Instructors and designers could collect "big data" on learner behaviors and performance, allowing for more personalized and adaptive learning paths. Instructional design has begun to shift toward a learner-centric mindset, emphasizing not just learning outcomes but the overall learner experience. This gave rise to concepts like Learning Experience (LX) design, which focuses on creating human-centered, goal-oriented learning environments optimized for engagement and efficacy (Floor, 2023).

Starting in the late 2010s, AI-empowered instructional design took root in the e-learning industry, where it was quickly recognized for its ability to automate the instructional design process and content creation, personalize learning experiences, and enhance learner engagement (Bates, 2019; Holmes et al., 2019). This early adoption in the corporate and e-learning industry demonstrated significant improvements in efficiency and scalability (Gibson, 2023). More recently, higher education institutions have actively explored and integrated AI-powered instructional design to innovate traditional academic practices and meet evolving educational demands (Brandon, 2024; Fang & Broussard, 2024).

As an emerging area of practice, the integration of AI into instructional design represents a new and rapidly evolving frontier in higher education (Bora & Kölemen, 2025). The systematic review reported here examined the current landscape of AI-powered instructional design, with a particular focus on understanding how AI tools are being adopted, applied, and challenged within higher education settings. Three key research questions guided this study.

- RQ1. What AI tools are currently used to support instructional design practices in higher education?
- RQ2. What roles do these AI tools play within instructional design practices in higher education?
- RQ3. What technology leadership challenges arise when integrating AI tools into instructional design processes in higher education?

Methods

This study employed a systematic search strategy using the keywords “artificial intelligence” OR “AI” AND “instructional design” AND “higher education” OR “learning design” across article titles, abstracts, and keywords in ERIC (36 results), Scopus (52 results), Web of Science (139 results), and Google Scholar (up to 100 records). The review period was set from January 2020 to February 2025 to capture recent developments spurred by rapid AI advancements and the COVID–19–induced shift to online and blended learning, ensuring coverage of the most relevant innovations in AI-driven instructional design. Notably, a high percentage of articles focused on AI for direct teaching or learning activities without explicitly linking it to instructional design. Such studies were excluded. See Table 1 for the inclusion and exclusion criteria.

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021), widely adopted to enhance methodological rigor, were followed to identify, screen, and select eligible studies. A total of 327 articles published between January 2020 and February 2025 were retrieved from ERIC, Web of Science, Scopus, and Google Scholar, resulting in a final set of 35 articles that met the inclusion criteria. See Figure 1 for the PRISMA flow chart.

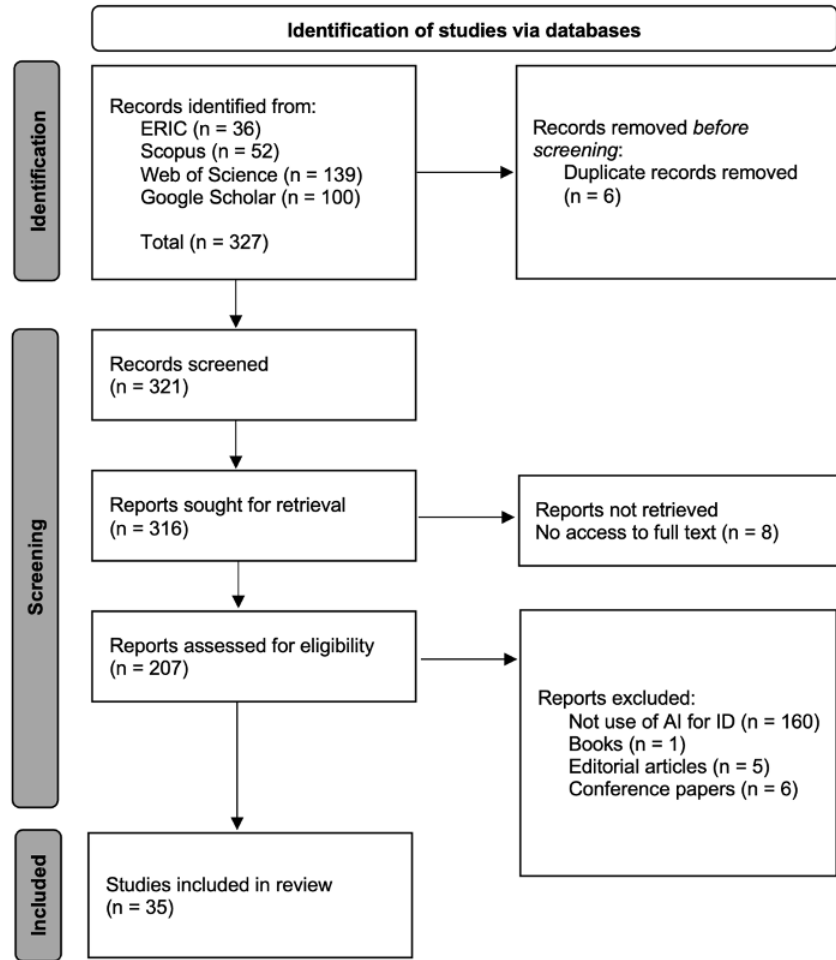
Table 1
Inclusion and Exclusion Criteria

Criteria	Included	Excluded
Databases	Education Resources Information Center (ERIC), Web of Science (WoS), Scopus, Google Scholar	
Publication Type	Peer-reviewed journal articles, book chapters	Books, editorials, conference proceedings, dissertations, reports, policy briefs
Language	Full text written in English	Full text written in other languages
Time Frame	January 2020 – February 2025	Articles published before 2020 and after February 2025
Participants	Not applicable	Not applicable
Target Setting	Higher education institutions	K-12, industry
Focus	AI integration for instructional design process, strategies, practices, assessment, models, frameworks, guidelines	Solely on AI applications for direct teaching or learning activities that do not involve the systematic design of learning experiences
Access	Have access to full-text, have access to enough information	No access to full text, no access to enough information

The coding strategies were carefully developed to address the three research questions. Each article was coded for authorship, publication year, and country or region of the first author, helping identify trends in AI-powered instructional design research across regions and time frames and revealing global patterns. Specific AI tools were also coded for later categorization of the types of AI technology used for instructional design. For questions 2 and 3, the grounded coding technique (Strauss & Corbin, 1995) was used to identify and synthesize how exactly AI is being used in instructional design with both benefits and challenges. Two researchers coded and reached an interrater percentage agreement of 100% on the codes.

Thematic analysis (Thomas & Harden, 2008) was applied to synthesize coded data into overarching themes, systematically uncovering patterns in AI's instructional design applications. To ensure rigor, we engaged in repeated discussions, reconciling interpretations until achieving 100% consensus on the finalized themes.

Figure 1
PRISMA Flowchart (Page et al., 2021)



Results

This section begins with an overview of the metadata, including the country of the first author and the year of publication for each article. The section then explores the AI programs used in instructional design, their specific contributions to instructional practices, and the challenges encountered in integrating AI into these processes.

Study Distribution Across Countries and Years

Figure 2 presents a bar graph illustrating the frequency of countries represented across the 35 articles. As shown, the US has the highest representation, with the majority of articles originating from there. China (combining both China and Hong Kong — a Special Administrative Region of China) is the second most frequent country. Canada appears next,

contributing a smaller number of articles. Other countries are also represented, though with fewer publications. This graph highlights the global reach of the use of AI in instructional design, with a notable concentration in the US and China.

Figure 2
Geographical Distribution of Studies

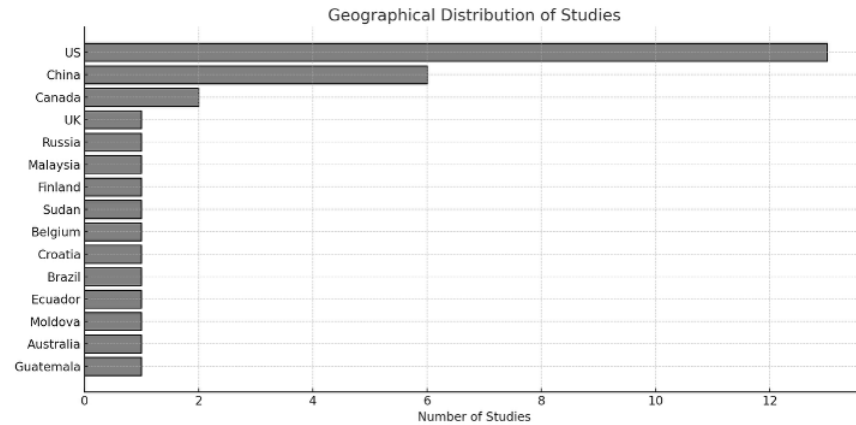
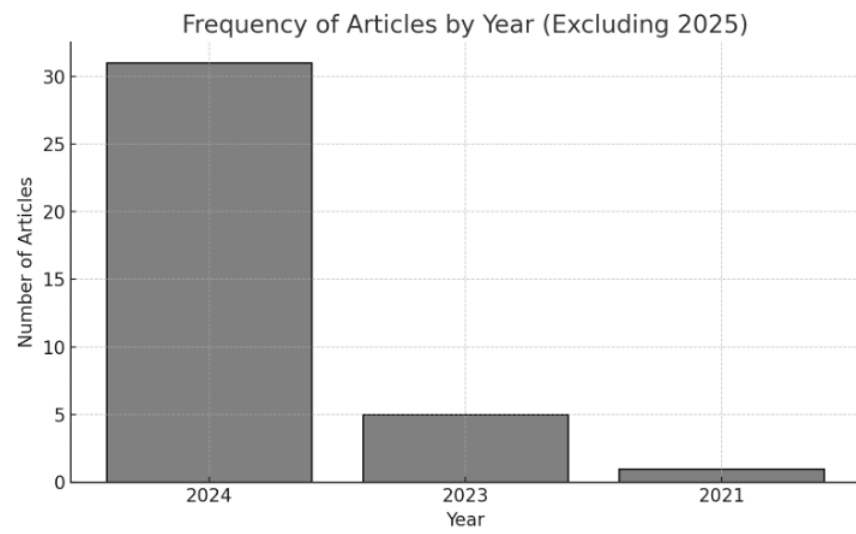


Figure 3, Frequency of Studies by Year (excluding 2025), illustrates the distribution of articles published in different years. The majority of the studies are from 2024, indicating a peak in AI-related instructional design research during that year. Fewer articles were published in 2023, and even fewer in 2022 and 2021. 2025 is not represented in the graph due to the data cutoff being in February 2025. The graph highlights the growing focus on AI in instructional design, particularly in 2024, showcasing the significant rise in interest and research starting in 2024.

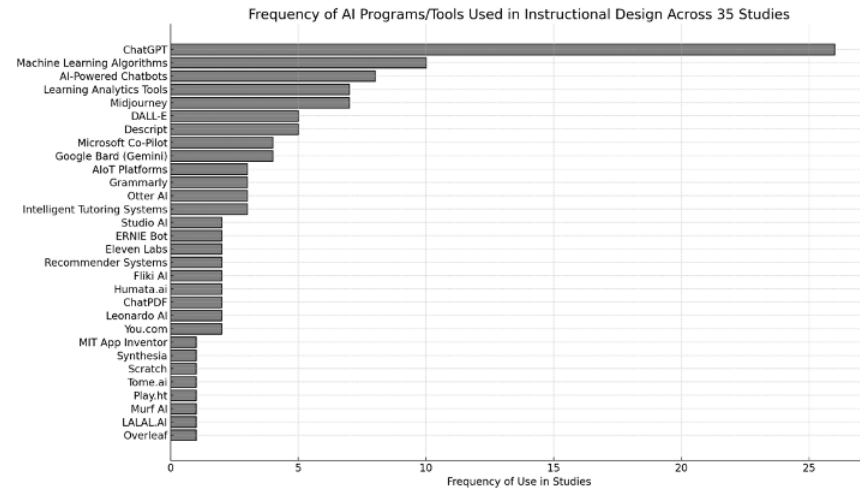
Figure 3
Frequency Distribution by Year (Excluding 2025)



RQ1

Across the 35 reviewed studies, a diverse range of AI tools were employed to support key instructional design functions. The findings reveal that AI programs were extensively used for content creation, media production, assessment generation, learner support, and personalization of learning experiences. The tools varied in their technical sophistication, ranging from general-purpose large language models (LLMs) to specialized multimedia generation programs and learning analytics systems.

Figure 4
Frequency Distribution of AI Programs/Tools



Most Frequently Used AI Tool: ChatGPT

ChatGPT emerged as the most widely used AI tool, appearing in 26 out of the 35 studies (e.g., Amado-Salvatierra et al., 2023; Bolick & da Silva, 2024; Ch'ng, 2023; Choi et al., 2024; Conklin et al., 2024; DaCosta & Kinsell, 2024; Madunić & Sovulj, 2024). By leveraging extensive datasets such as books, web crawls, and encyclopedias, ChatGPT generates contextually relevant and coherent content in response to human prompts (IEEE Spectrum, 2024). ChatGPT’s accessibility and versatility made it a popular choice for a wide variety of instructional design tasks. It was commonly used to generate course outlines, learning objectives, assessment items (quizzes, rubrics, peer assessments), lecture scripts, case scenarios, and feedback messages. In addition, ChatGPT was used for brainstorming ideas, refining drafts, translating complex content into simpler language, and exploring alternative explanations for learners (Conklin et al., 2024; Hodges & Kirschner, 2023).

AI Tools for Multimedia Creation

Several studies employed AI tools to automate the creation of multimedia assets, which are crucial in online and blended learning environments. The

affordances of multimedia play an important role in providing authentic, real-world learning experiences in digital learning environments. Image-generation tools such as Midjourney (Bolick & da Silva, 2024; Kumar et al., 2024) and DALL-E (Chai et al., 2025; Sankaranarayanan & Park, 2024) were used to create visual content, infographics, illustrations, and scenario images for instructional materials. Tools like Synthesia, Murf AI, and LALAL.AI (Ch'ng, 2023) supported video creation and audio editing, while Descript (Bolick & da Silva, 2024; Kumar et al., 2024) and Eleven Labs (Kumar et al., 2024) enabled voiceover generation, transcription, and audio refinement. Tools such as Tome.ai (Amado-Salvatierra et al., 2023) were also used for generating presentation materials. Together, these AI programs span a spectrum of multimodal capabilities, ranging from static image and graph generation to audio creation and refinement and extending to full video and presentation production.

Machine Learning, Learning Analytics, and Adaptive Systems

Machine learning (ML) algorithms and learning analytics tools were used in 10 studies (e.g., Deng, 2024; Drugova et al., 2022; Fan et al., 2021; Plumley et al., 2024) to analyze learner data, predict student performance, identify learning patterns, and provide real-time feedback. Process mining, cluster analysis, and epistemic network analysis were specifically applied to understand learner behavior in self-regulated learning environments (Fan et al., 2021). Learning analytics dashboards and predictive models enabled personalized learning pathways and timely instructor interventions. Adaptive learning systems, intelligent tutoring systems (ITS), and recommender systems were also integrated to deliver tailored content and automated feedback based on learners' performance (Drugova et al., 2022; Edam, 2024; Railean et al., 2023; Stefaniak & Moore, 2024).

AI Chatbots for Learner Support and Self-Regulated Learning

AI-powered chatbots were utilized in eight studies to foster self-regulated learning (SRL), provide personalized feedback, and enhance learner autonomy in instructional design. These chatbots supported SRL processes such as goal setting, monitoring, reflection, and task management. Notable examples include EDUguia (Gazulla et al., 2023), a chatbot codesigned through a participatory process involving educators, designers, and stakeholders, to scaffold SRL in higher education; ERNIE Bot (Liu et al., 2024), which assisted preservice teachers in lesson planning; and course-specific chatbots for learner inquiry and navigation (Chang et al., 2024; Madunić & Sovulj, 2024).

Beyond SRL, chatbots were integrated into adaptive learning systems, providing real-time feedback and personalized support (Drugova et al., 2022; Edam, 2024). Railean et al. (2023) further conceptualized chatbots as key components of educational ecosystems, supporting cognitive, metacognitive, and emotional engagement. Collectively, these studies framed AI chatbots as pedagogical agents that enhance personalization and feedback in instructional design, while underscoring thoughtful human-AI integration as a critical factor in effective AI-powered design.

AI Tools Supporting Specific Instructional Design Tasks

Several studies highlighted specialized AI tools designed to address targeted instructional design tasks. These tools can be grouped into four functional categories: (a) accessibility and transcription, which support inclusive design and broaden learner participation, (b) content enhancement and writing support, aiding instructors in refining instructional materials, (c) multimedia generation and summarization, facilitating the creation of engaging and adaptable learning resources, and (d) digital literacy development, equipping learners with the skills needed to navigate AI-mediated learning environments. While some of these functions overlap with Universal Design for Learning (UDL) principles (Hall et al., 2012), the studies positioned them primarily as supports for instructional design practice.

For improving accessibility and learner engagement through auditory formats, Play.ht was used to convert written content into audio (Amado-Salvatierra et al., 2023), and Otter AI supported automatic transcription of recorded lectures (Kumar et al., 2024). For writing support and editing, Grammarly was employed to enhance the clarity, coherence, and grammatical accuracy of instructional materials (Kumar et al., 2024; Luo et al., 2024). For multimedia production and content summarization, programs such as Fliki AI, Humata.ai, Studio AI, ChatPDF, Leonardo AI, and You.com enabled instructional designers to generate videos, summarize documents, and create engaging visual content (Ruiz-Rojas et al., 2023).

Additionally, programs that supported computational thinking and project-based learning included MIT App Inventor and Scratch, which were used to facilitate AI-integrated coding and artifact development (Weng et al., 2024), while AIoT platforms enabled learners to build intelligent systems combining AI and the Internet of Things technologies. Finally, Overleaf was used in conjunction with ChatGPT to cocreate mind maps and organize course structure, demonstrating AI's role in supporting collaborative design tasks (Amado-Salvatierra et al., 2023).

Overall, this review highlights a rapidly expanding ecosystem of AI programs integrated into instructional design, building on the field's longstanding practice of using multimedia to enhance teaching and learning. Instructional designers have historically leveraged text, visuals, audio, and video to create engaging, accessible, and learner-centered experiences. The advent of AI has great potential to amplify this capability, offering new levels of efficiency and scalability in content and multimedia creation. ChatGPT emerged as the most frequently used tool, valued for its versatility in content generation and ideation. Visual, audio, and video generation programs such as Midjourney, DALL-E, Synthesia, and Descript further extended the multimodal possibilities of instructional materials, allowing designers to rapidly produce customized learning assets. Additionally, machine learning algorithms and learning analytics enabled adaptive learning and personalized instruction, while AI-powered chatbots and tutoring systems supported self-regulated learning and learner engagement.

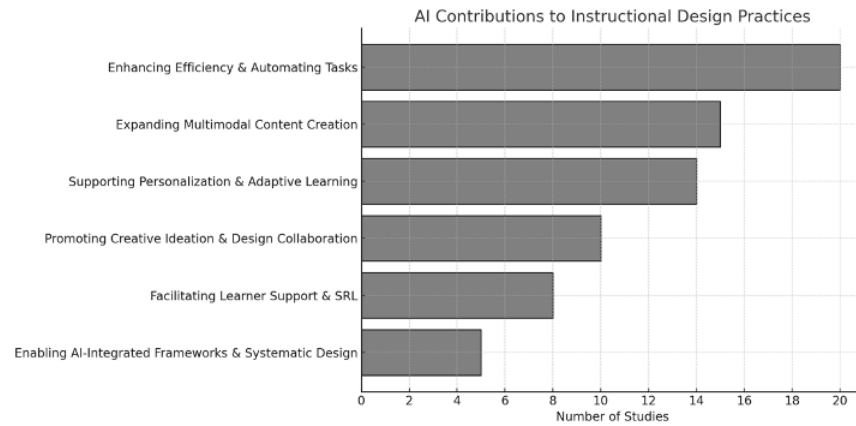
To translate this tool-rich landscape into sustainable practice, higher education needs instructional designers to exercise technology leadership — not merely to use tools. They must lead faculty development in AI-powered teaching, learning, and assessment, including work on prompting patterns, multimodal design, and evaluation rubrics. Without deliberate leadership to orchestrate AI tools, pedagogy, and university platforms, the promise of these tools will remain fragmented and fail to produce evidence-based improvements in teaching, learning, and assessment.

RQ2

While results from RQ1 identified a wide array of AI tools adopted in instructional design practices, from generative AI tools like ChatGPT to machine learning-driven analytics, multimedia creation tools, and adaptive learning systems, data collected to answer RQ 2 extended this analysis by examining how these tools were operationalized within instructional design workflows. The findings show that the choice of AI tools was not only driven by their technical capabilities but also shaped by the ways they contributed to solving specific instructional design problems, enhancing the design process, and supporting teaching and learning goals.

Across the literature, this review identified six emerging roles of AI in instructional design: (a) enhancing efficiency and automating tasks, (b) expanding multimodal content creation, (c) supporting personalization and adaptive learning, (d) facilitating learner support and self-regulated learning, (e) promoting creative ideation and design collaboration, and (f) enabling AI-integrated frameworks and systematic design.

Figure 5
Key Roles of AI in Supporting Instructional Design Practices



Enhancing Efficiency and Automating Repetitive Tasks

A primary role of AI tools in instructional design is improving efficiency, particularly by automating repetitive and time-consuming tasks. Across numerous studies, tools like ChatGPT were used to rapidly generate course

outlines, learning objectives, assessment items, feedback messages, and instructional content drafts (e.g., Amado-Salvatierra et al., 2023; Choi et al., 2024; Hu et al., 2024; McNeill, 2024). Tools such as Microsoft Co-Pilot and Google Bard (now Gemini; Kumar et al., 2024; Luo et al., 2024) further supported content summarization, language editing, and brainstorming, enabling instructional designers to devote more time to higher order design decisions and pedagogical considerations. The automation of initial content generation allowed for quicker prototyping of instructional materials, accelerating the iterative design process.

Expanding Multimodal Content Creation

AI tools played a critical role in expanding the multimodal capabilities of instructional materials. Image-generation tools like Midjourney and DALL-E enabled the creation of customized visuals, infographics, and scenario-based images, addressing the challenge of limited graphic design resources (Bolick & da Silva, 2024; Kumar et al., 2024). Audio and video tools such as Descript, Eleven Labs, and Synthesia facilitated the production of voiceovers, video lectures, and podcasts (Ch'ng, 2023; Kumar et al., 2024). Other tools like Tome.ai and Fliki AI helped generate engaging presentations and multimedia assets (Amado-Salvatierra et al., 2023; Ruiz-Rojas et al., 2023), enriching the learner experience with diverse media formats.

Supporting Personalization and Adaptive Learning

Many studies demonstrated AI's contribution to personalized learning design through machine learning algorithms, learning analytics tools, and adaptive systems. AI-supported dashboards and predictive analytics provided insights into learner behaviors, enabling instructional designers to identify at-risk students, tailor content, and adapt learning pathways in real time (Deng, 2024; Plumley et al., 2024). Learning analytics tools like cluster analysis, process mining, and epistemic network analysis facilitated a deeper understanding of learners' strategies and engagement patterns, supporting data-driven instructional refinement (Fan et al., 2021).

Promoting Creative Ideation and Design Collaboration

AI tools also supported instructional designers in creative tasks such as brainstorming ideas, generating alternative perspectives, and refining content for diverse learner needs. Several studies described ChatGPT's role as a cocreator or ideation partner, helping designers overcome creative blocks and explore varied instructional strategies (Bolick & da Silva, 2024; McNeill, 2024). In collaborative settings, AI tools were used to facilitate codesign activities, such as using Overleaf and ChatGPT for mind-mapping course structures (Amado-Salvatierra et al., 2023) or GPT-powered chatbots trained on instructional design models to support novice designers (Krushinskaia et al., 2024).

Facilitating Learner Support and Self-Regulated Learning

AI-powered chatbots were widely used to foster self-regulated learning (SRL) by guiding students in goal setting, task management, reflection, and self-assessment (Leung et al., 2024). Examples include the EDUguia chatbot (Gazulla et al., 2023), ERNIE Bot (Liu et al., 2024), and customized course-based chatbots (Madunić & Sovulj, 2024). These tools provided personalized feedback, answered learner queries, and facilitated SRL processes, acting as virtual learning companions within the instructional design environment (Chang et al., 2024).

Enabling AI-integrated Frameworks and Systematic Design

Some studies moved beyond tool adoption to propose frameworks integrating AI into established instructional design processes. For example, the GAIDE (Generative AI for Instructional Development and Education) framework (Dickey & Bejarano, 2024) offered a structured, systematic approach to leverage generative AI in course content development through iterative content refinement at both the macro level (overall structure and flow) and micro level (detailed content polishing).

In comparison, Krushinskaia et al. (2024) experimented with customizing the standard version of GPT-4 bots fine-tuned on a summarized version of the Dick and Carey instructional design model to guide teachers step-by-step through lesson planning. This research highlighted how AI, when aligned with established instructional design frameworks, can act as a scaffolding tool that supports educators without replacing their creative and critical judgment.

Overall, the findings from RQ 2 demonstrated that the AI tools identified in RQ 1 were leveraged in diverse and meaningful ways to transform instructional design practices. The versatility of ChatGPT, as the most widely adopted tool, was reflected in its contributions across content generation, brainstorming, assessment design, and feedback creation. Meanwhile, multimedia generation tools such as Midjourney, DALL-E, and Descript were employed to enrich the multimodal learning experience, while machine learning algorithms and learning analytics enabled data-informed personalization and adaptive learning pathways. AI-powered chatbots and intelligent tutoring systems further extended instructional designers' capacity to support learners' self-regulation and autonomy.

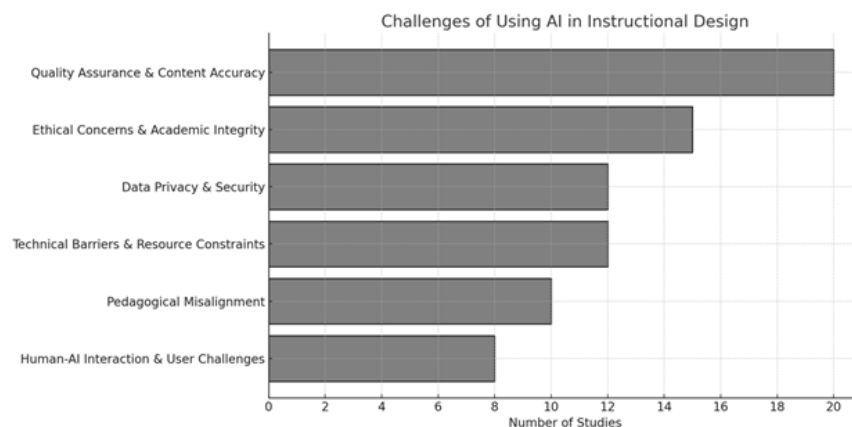
Importantly, several studies moved beyond isolated tool use to experiment with AI-integrated frameworks that aligned technological affordances with instructional design principles. These patterns have reinforced the central finding from RQ 1: Instructional designers were not merely adopting AI tools for isolated tasks but increasingly curating and integrating multiple AI tools to enhance creativity, efficiency, personalization, and learner support, positioning AI as an embedded and strategic component of modern instructional design practice. In doing so, instructional designers act as catalysts of pedagogical innovation, leading the exploration of the emerging synergy between AI's technological affordances and corresponding pedagogical benefits, and advancing

traditional higher education goals to encompass AI literacy – the digital literacy demanded by the present and future workforce.

RQ3

While the integration of AI tools has expanded the technological and pedagogical possibilities of instructional design, the studies reviewed also reveal a wide range of challenges that instructional designers must navigate as academic technology leaders. These challenges clustered around six major themes: (1) quality assurance and content accuracy, (2) ethical concerns and academic integrity, (3) data privacy and security, (4) technical barriers and resource constraints, (5) pedagogical misalignment, and (6) human-AI interaction complexities and user challenges.

Figure 6
Challenges of Using AI in Instructional Design



Quality Assurance and Content Accuracy

One of the most frequently reported challenges was the need for substantial human intervention to verify, refine, and contextualize AI-generated content. Across multiple studies, instructional designers expressed concerns about the generic, inaccurate, or contextually inappropriate outputs produced by tools like ChatGPT and other generative AI platforms (Conklin et al., 2024; Liu et al., 2024; Meron & Araci, 2024). Problems such as factual inaccuracies, lack of depth, and template-like outputs were common, necessitating careful review to ensure content accuracy, relevance, and alignment with specific learning goals.

Ethical Concerns and Academic Integrity

Similar to AI use in other contexts, ethical challenges related to the use of AI were a prominent theme. These included concerns over plagiarism, misuse of AI-generated content, bias in algorithms, and the potential erosion of creativity and critical thinking if users over-relied on AI (Hodges et al., 2023; Sankaranarayanan & Park, 2024). Some studies also highlighted risks associated with copyright infringement in AI-generated

images (Bolick & da Silva, 2024) and challenges in maintaining originality and authorship clarity when using AI tools for content generation (Luo et al., 2024; Madunić & Sovulj, 2024). In the context of instructional design, these ethical concerns are especially salient in relation to copyright issues surrounding AI-generated learning assets — an emerging frontier with no clear answers.

Data Privacy and Security

The use of AI tools that collect, process, or store learner data raised concerns about data privacy, ownership, and security. This issue was particularly critical in learning analytics and adaptive systems, where sensitive learner information was collected to provide personalized feedback (Malone, 2024; Plumley et al., 2024). Malone further highlighted risks of algorithmic bias embedded in AI systems, which can perpetuate inequities and unfair treatment of learners. Additionally, Malone underscored the lack of transparency in how AI models are used and processed educational data, calling for ethical guidelines to ensure accountability and protect learner autonomy.

Technical Barriers and Resource Constraints

Several studies reported that the successful use of AI tools required significant technical expertise and infrastructure that might not be readily available to all instructional designers or institutions. Drugova et al. (2022) highlighted challenges such as the complexity and opacity of AI algorithms, the need for advanced data management skills, and the demand for computational resources to effectively process multimodal educational data. Similarly, Rossi (2021) highlighted technical barriers in data science education, such as the need for modern infrastructure, software access, and educator skills in programming and machine learning, which are especially difficult for resource-limited institutions. These challenges are further compounded by the high costs of advanced AI tools and the need for specialized training, limiting adoption in smaller or under-resourced educational settings (Ruiz-Rojas et al., 2023).

Pedagogical Misalignment and Loss of Human-Centered Design

Another recurring concern was the risk of AI-generated content driving instructional design processes in ways that might neglect contextual, creative, or learner-centered elements. AI tools sometimes suggested inapplicable learning activities (e.g., in-person activities for online courses) or failed to account for socio-emotional and cultural aspects of learning (Edam, 2024; Railean et al., 2023). Some scholars cautioned against overautomating design processes and emphasized the need to preserve human creativity, empathy, and pedagogical judgment within AI-supported instructional design (Czerkowski, 2024; Dickey & Bejarano, 2024).

Human-AI Interaction and User Challenges

Finally, the studies highlighted challenges related to human-AI interaction, including difficulties in prompt design, communicating intent effectively to AI, and managing AI's limited contextual awareness (Liu et al., 2024; Luo et al., 2024). Some chatbots and AI systems struggled with natural language understanding or produced inconsistent outputs across design iterations (Conklin et al., 2024). Moreover, instructional designers reported a need for clearer institutional guidelines and faculty development initiatives to support the ethical and effective use of AI tools (Ruiz-Rojas et al., 2023; Weber et al., 2024).

In sum, while AI tools have introduced new opportunities for efficiency, creativity, and personalization in instructional design, their use also presents multilayered challenges. Some of these challenges, such as ensuring information accuracy and sustaining learner engagement, are not unique to AI but have become more pronounced in AI-mediated environments.

At the same time, AI has introduced new and distinct challenges, most notably, the risk of overreliance on AI-generated content due to its speed and efficiency. This overreliance can lead to diminished critical thinking, reduced learner agency, and a weakening of pedagogical intentionality. These challenges are not merely technical but also deeply pedagogical, ethical, and policy-related, requiring instructional designers to serve as a critical bridge—communicating and mediating between university academic affairs for policymaking and faculty and students in their use of AI.

Discussion

The findings from this review offer several important implications for the field of instructional design, particularly in an era where AI tools are rapidly reshaping design practices, processes, and professional roles. Across the 35 studies, three key implications emerge related to tool integration, evolving designer roles, and necessary professional competencies.

Implications

Instructional Design as Multitool Integration and Orchestration

First, the findings from RQ 1 and RQ 2 underscore that instructional design is increasingly becoming a practice of multitool integration and orchestration. While ChatGPT clearly dominated the landscape as the most frequently used tool for content generation, ideation, and feedback, instructional designers also engaged a wide range of specialized AI tools for multimedia creation, learning analytics, adaptive systems, and learner support. This multitool ecosystem requires designers not only to select appropriate tools but also to combine them strategically to create dynamic, multimodal, and personalized learning environments. This highlights instructional design as a practice of orchestration, where designers must thoughtfully align AI tools with pedagogical goals, learner needs, and

instructional contexts. As technology leaders, instructional designers also set integration patterns and guardrails (e.g., accessibility, privacy, integrity), broker interoperability with the LMS and campus platforms, and lead cross-unit change efforts so that multitool workflows are scalable, sustainable, and evidence-based (Bond et al., 2023).

Expanding the Role of Instructional Designers as Mediators and Curators of AI

The findings from RQ 2 and RQ 3 further illustrate the evolving role of instructional designers from content creators to curators, mediators, and critical evaluators of AI-generated outputs. AI tools may automate routine tasks, but they also introduce new design challenges, particularly around quality assurance, ethical use, and pedagogical alignment. Designers are increasingly positioned as mediators between what AI tools can produce and what is pedagogically appropriate, contextually relevant, and ethically sound for learners. This expanded role requires instructional designers to engage critically with AI outputs, ensure content accuracy, maintain learner-centered design principles, and address concerns related to bias, plagiarism, data privacy, and learner trust. In a technology-leadership capacity, instructional designers formalize Q&A pipelines and model-use protocols, translate policy into course-level practices (e.g., assessment redesign, citation norms), and convene faculty, instructional technology, and compliance stakeholders to balance innovation with risk management (Kumar & Ritzhaupt, 2017).

Growing Need for AI Literacy, Data Literacy, and Prompt Design Competencies

Finally, the challenges identified in RQ 3 reveal critical competency gaps that instructional designers must address to leverage AI tools effectively. Beyond technical proficiency, instructional designers need AI literacy — an understanding of how AI works, its limitations, and ethical implications — as well as data literacy to interpret learning analytics and use machine learning outputs responsibly. Moreover, prompt design or prompt engineering emerged across studies as an essential skill for maximizing the effectiveness of generative AI tools like ChatGPT.

As an essential competency in the AI age (Qian, 2025), the ability to craft strategic prompts, iteratively refine interactions with AI, and critically evaluate generated content represents a developing area of expertise for instructional designers in aligning AI use with instructional goals. Exercising technology leadership, instructional designers can architect campus-wide capacity building in professional development programs in AI literacy, curating prompt libraries, and establishing data-governance and analytics-ethics norms (Kassorla et al., 2024).

Instructional designers' role as catalyst for academic innovation has long been championed (Beirne & Romanoski, 2018). This review has suggested more emerging leadership roles in the AI era: the future of instructional design is not about AI replacing designers but about elevating their roles as orchestrators, curators, and ethical stewards of AI-powered learning environments. Effective integration of AI tools requires not only technical

skills but also deep pedagogical knowledge, contextual sensitivity, and a commitment to human-centered design principles. Critically, it also requires technology leadership — aligning technology, pedagogy, people, processes, and platforms; securing resources; establishing governance and accountability; and leading faculty development — so that AI adoption produces meaningful and measurable improvements in teaching, learning, and assessment.

Limitations

While this review provides important insights into the use of AI in instructional design, several limitations should be acknowledged. First, the review included peer-reviewed studies published between January 2020 and February 2025, which means that more recent developments and practices may not be captured, potentially affecting the timeliness and relevance of the conclusions. Additionally, this review focused exclusively on scholarly literature, which may have excluded emerging practices documented in gray literature or industry reports, where innovations in AI use often evolve more rapidly.

Second, a substantial proportion of the 35 studies were theoretical or conceptual rather than empirical. While these studies offered valuable perspectives on emerging frameworks and possibilities, the limited number of empirical studies constrains the strength and generalizability of overarching conclusions, particularly regarding the actual impact of AI tools in practice. Moreover, variations in the depth and specificity of reporting across studies, with some referring broadly to “AI programs” or “AI tools” without specifying platforms or functionalities, further limited consistency in analysis, especially for RQ 2 and RQ 3.

Third, this review was intentionally framed around three focused research questions, which provided structure but may have narrowed the scope of analysis. This deliberate focus might have overlooked important nuances or emergent themes beyond these questions, limiting the review’s ability to fully capture the breadth and complexity of AI’s evolving role in instructional design.

Future Directions

Building on the findings and limitations of this review, several directions for future research on AI in instructional design are evident. First, there is a need for more empirical studies that move beyond tool demonstrations to examine how AI integration shapes instructional design processes, decision-making, and outcomes over time. Longitudinal and design-based research could provide deeper insights into how instructional designers develop competencies in working with AI, adapt their workflows, and navigate evolving pedagogical and ethical challenges.

Second, future research should explore the learner experience in AI-supported environments more systematically. While many studies focused on how instructional designers use AI, fewer examined how learners interact with AI-generated content, chatbots, or adaptive systems, and how these experiences affect engagement, learning, and trust. Investigating learner perspectives will be essential for ensuring that AI-

enhanced instructional design remains learner-centered and responsive to diverse needs.

Third, as AI tools become multimodal, future research should focus on how instructional designers manage multiple AI tools within a single design ecosystem. This includes strategies for ensuring tool interoperability, where outputs from one tool can be used by others. Research should also examine how AI-generated text, visuals, audio, and data align with pedagogical goals, ensuring these outputs enhance learning. Moreover, quality control measures are needed to maintain high standards across different media types, ensuring accuracy and relevance in AI-generated content.

Fourth, research should explore the development of AI literacy and prompt engineering in instructional design education. As AI tools become integral, designers must develop specific skills to use them effectively and ethically. Studies should examine the knowledge and competencies required for instructional designers, focusing on prompt creation, AI capabilities, and ethical considerations. Research could also explore how AI literacy can be integrated into instructional design curricula and professional development, preparing both future and current designers to adapt to AI's evolving role in education.

Fifth, while some studies have begun to explore frameworks for AI-integrated instructional design (e.g., Dickey & Bejarano, 2024), future research needs to critically reassess traditional instructional design models, such as ADDIE, in light of AI integration. Specifically, research should explore how AI can collaborate with instructional designers in a more scaffolded manner, enhancing their creativity and critical thinking while also improving operational efficiencies. This shift may require a more dynamic model, as the traditional systematic instructional design models that have dominated for decades may no longer be sufficient. What AI-integrated instructional design will ultimately look like remains unclear, making this an essential area for future exploration.

Finally, from a technology leadership perspective, instructional design in the AI age is more than a site of adaptation; it is a catalyst for academic innovation. As AI accelerates changes in teaching, learning, and knowledge production, instructional designers are uniquely positioned to lead institutional conversations about not only harnessing AI's potential but also confronting its ethical, equity, and policy challenges. Issues of bias, data privacy, authorship, and academic integrity demand proactive frameworks and guidelines to ensure that AI is implemented responsibly and that human-centered learning remains at the core.

To move these directions forward, technology leadership from instructional designers should concentrate on three moves. First, build an evidence infrastructure — research–practice partnerships with shared metrics and light, repeatable evaluations to track how AI reshapes design and learning over time. Second, center learner experience with governance — continuous feedback loops and cross-functional bodies that translate ethics, equity, privacy, and integrity policies into course-level practice. Third, orchestrate ecosystems and capacity — an interoperable AI-tool stack and campus-wide development in AI/data literacy and prompt craft, supported by curated prompt libraries and clear Q&A norms. With these

moves, instructional designers can shift AI-powered instructional design from isolated tool demonstrations and ad hoc integrations to scalable, responsible academic innovation.

Conclusion

This systematic review examined 35 studies to explore the ways AI tools are used in instructional design, how these tools contribute to design practices, and the challenges associated with their integration. The findings demonstrate that AI is not merely a set of tools layered onto existing practices, but a powerful catalyst for transforming teaching and learning.

AI's unique roles of instructional design include personalizing learning, accelerating content development, supporting adaptive pathways, and fostering creativity, which signals a new era of academic innovation. While tools like ChatGPT dominate current use cases — valued for content generation, idea refinement, and feedback — the broader landscape of AI tools extends to multimedia creation, adaptive learning, personalized feedback, and learner support, opening new possibilities for reimagining teaching and learning.

At the same time, these opportunities come with profound challenges. Issues of content quality, ethical use, data privacy, technical barriers, pedagogical alignment, and human-AI interaction highlight the continued need for instructional designers to serve as ethical stewards, critical mediators, and strategic leaders in this evolving landscape.

AI amplifies both the possibilities and the responsibilities of instructional design. Ultimately, this review underscores that instructional design in the AI age is a driving force for academic innovation. The transformative power of AI demands not only technological adoption but also intentional, human-centered design leadership. The future of instructional design lies in building designers' capacity to harness AI critically, creatively, and ethically, ensuring that educational transformation advances agency, innovation, and meaningful learning.

References

* Indicates the studies are included in the systematic review.

*Amado-Salvatierra, H. R., Morales Chan, M., & Hernandez-Rizzardini, R. (2023). Combining human creativity and AI-based tools in the instructional design of MOOCs: Benefits and limitations. In *Proceedings of 2023 IEEE Learning with MOOCs* (pp. 1–6). IEEE. <https://doi.org/10.1109/LWMOOCs58322.2023.10306023>

Bates, T. (2019). *Teaching in a digital age: Guidelines for designing teaching and learning*. British Columbia/Yukon Pressbooks.

Beirne, E., & Romanoski, M. O. (2018). *Instructional design in higher education: Defining an evolving field* [White paper]. OLC Research Center for Digital Learning & Leadership. <https://olc-wordpress->

assets.s3.amazonaws.com/uploads/2018/07/Instructional-Design-inHigher-Education-Defining-an-Evolving-Field.pdf

*Bolick, A. D., & da Silva, R. L. (2023). Exploring artificial intelligence tools and their potential impact on instructional design workflows and organizational systems. *TechTrends*, 68(1), 91–100. <https://doi.org/10.1007/s11528-023-00894-2>

Bond, A., Lockee, B., & Blevins, S. (2023, October 31). Instructional designers as institutional change agents. *Educause*. <https://er.educause.edu/articles/2023/10/instructional-designers-as-institutional-change-agents>

Bora, B. Y., & Kölemen, C. Ş. (2025). Integrating AI into instructional design: A case study on digital photography education in higher education. *Contemporary Educational Technology*, 17(3), ep583. <https://doi.org/10.30935/cedtech/16433>

Brandon, B. (2024). *Use AI intelligently: Design challenges and considerations*. The Learning Guild. <https://www.learningguild.com/articles/use-ai-intelligently-design-challenges-considerations>

*Chai, D. S., Kim, H. S., Kim, K. N., Ha, Y., Shin, S. S. H., & Yoon, S. W. (2025). Generative artificial intelligence in instructional system design. *Human Resource Development Review*. <https://doi.org/10.1177/15344843251320256>

*Chang, D. H., Lin, M. P.-C., Hajian, S., & Wang, Q. Q. (2024). Educational design principles of using an AI chatbot that supports self-regulated learning in education: Goal setting, feedback, and personalization. *Sustainability*, 15(12921). <https://doi.org/10.3390/su151712921>

*Ch'ng, L. K. (2023). How AI makes its mark on instructional design. *Asian Journal of Distance Education*, 18(2), 32–34. <http://www.asianjde.com/>

*Choi, G. W., Kim, S. H., Lee, D., & Moon, J. (2024). Utilizing generative AI for instructional design: Exploring strengths, weaknesses, opportunities, and threats. *TechTrends*, 68, 832–844. <https://doi.org/10.1007/s11528-024-00967-w>

*Conklin, S., Dorgan, T., & Barreto, D. (2024). Is AI the new course creator? *Discover Education*, 3(285). <https://doi.org/10.1007/s44217-024-00386-2>

*Czerkawski, B. (2024). AI and the learning experience design: From divergent creativity to convergent precision. *TechTrends*, 69, 260–270. <https://doi.org/10.1007/s11528-024-01032-2>

* DaCosta, B., & Kinsell, C. (2024) Investigating media selection through ChatGPT: An exploratory study on generative artificial intelligence in the aid of instructional design. *Open Journal of Social Sciences*, 12, 187-227. <https://doi.org/10.4236/jss.2024.124014>

*Deng, Y. (2024). A systematic review of the application of machine learning in curriculum design in higher education. *Journal of Emerging Computer Technologies*, 4(1), 15-24. <https://doi.org/10.57020/ject.1475566​>

Dick, W., Carey, L., & Carey, J. O. (2005). *The systematic design of instruction* (6th ed.). Allyn & Bacon.

*Dickey, E., & Bejarano, A. (2024). GAIDE: A framework for using generative AI to assist in course content development. In *Proceedings of 2024 IEEE Frontiers in Education Conference* (pp. 1–9). IEEE. <https://ieeexplore.ieee.org/document/10893132>

*Drugova, E., Zhuravleva, I., Zakharova, U., & Sotnikova, V. (2022). Artificial intelligence for learning analytics and instructional design steps: An overview of solutions. *Voprosy obrazovaniya / Educational Studies Moscow*. <https://doi.org/10.17323/1814-9545-2022-4-107-153​>

*Edam, S. M. I. (2024). AI in educational design and technological development. In Z. E. Ahmed, A. A. Hassan, & R. A. Saeed (Ed.), *AI-enhanced teaching methods* (pp. 25–60). IGI Global. doi:10.4018/979-8-3693-2728-9.ch002

*Fan, Y., Matcha, W., Uzir, N. A., Wang, Q., & Gašević, D. (2021). Learning analytics to reveal links between learning design and self-regulated learning. *International Journal of Artificial Intelligence in Education*, 31, 980–1021. <https://doi.org/10.1007/s40593-021-00249-z​>

Fang, B., & Broussard, K. (2024, August 7). Augmented course design: Using AI to boost efficiency and expand capacity. <https://er.educause.edu/articles/2024/8/augmented-course-design-using-ai-to-boost-efficiency-and-expand-capacity>

Floor, N. (2023). *This is learning experience design: What it is, how it works, and why it matters*. Pearson Education.

Gagné, R. M. (1965). *The conditions of learning*. Holt, Rinehart and Winston.

*Gazulla, E. D., Martins, L., & Fernández-Ferrer, M. (2023). Designing learning technology collaboratively: Analysis of a chatbot co-design. *Education and Information Technologies*, 28, 109–134. <https://doi.org/10.1007/s10639-022-11162-w​>

Gibson, R. (2023, August 14). *10 ways artificial intelligence is transforming instructional design*. <https://er.educause.edu/articles/2023/8/10-ways-artificial-intelligence-is-transforming-instructional-design>

Hall, T. E., Meyer, A., & Rose, D. H. (2012). *Universal design for learning in the classroom: Practical applications*. Guilford Press.

*Hodges, C. B., & Kirschner, P. A. (2023). Innovation of instructional design and assessment in the age of generative artificial intelligence.

TechTrends, 68, 195–199. <https://doi.org/10.1007/s11528-023-00926-x#8203>

Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign. <https://curriculumredesign.org/wp-content/uploads/AIED-Book-Excerpt-CCR.pdf>

*Hu, B., Zheng, L., Zhu, J., Ding, L., Wang, Y., & Gu, X. (2024). Teaching plan generation and evaluation with GPT-4: Unleashing the potential of LLM in instructional design. *IEEE Transactions on Learning Technologies*, 17, 1445–1460. <https://ieeexplore.ieee.org/document/10490240>

IEEE Spectrum. (2024). *What is generative AI? Spectrum explains large language models, the transformer architecture, and how it all works*. <https://spectrum.ieee.org/what-is-generative-ai>

Jonassen, D. H. (1991). Evaluating constructivist learning. *Educational Technology*, 31(9), 28–33.

Kassorla, M., Georgieva, M., & Papini, A. (2024). AI literacy in teaching and learning: A durable framework for higher education. *Educause*. <https://library.educause.edu/resources/2024/10/abstract-ai-literacy-in-teaching-and-learning-executive-summary-an-educause-working-group-paper>

*Krushinskaia, (2024). Effects of generative AI on instructional design. *Journal of Educational Technology*, 15(3), 45–67. doi: 10.1007/978-3-031-64312-5_49

*Kumar, S., Gunn, A., Rose, R., Pollard, R., Johnson, M., & Ritzhaupt, D. (2024). The role of instructional designers in the integration of generative AI in online and blended learning in higher education. *Online Learning*, 28(3), 207–231. doi: 10.24059/olj.v28i3.4501

Kumar, S., & Ritzhaupt, A. D. (2015). Knowledge and skills needed by instructional designers in higher education. *Performance Improvement Quarterly*, 28(3), 51–69. <https://doi.org/10.1002/piq.21196>

*Leung, J. K. L., Ng, D. T. K., & Tsui, C.-Y. (2024). A primer for design and systems thinkers: A first-year engineering course for mindset development. *Education Sciences*, 14(86). <https://doi.org/10.3390/educsci14010086>

*Liu, J., Li, S., & Dong, Q. (2024). Collaboration with generative artificial intelligence: An exploratory study based on learning analytics. *Journal of Educational Computing Research*, 62(5), 1234–1266. <https://doi.org/10.1177/07356331241242441>

*Luo, T., Muljana, P. S., Ren, X., & Young, D. (2024). Exploring instructional designers' utilization and perspectives on generative AI tools: A mixed methods study. *Education Tech Research and Development*. 73, 741–766. <https://doi.org/10.1007/s11423-024-10437-y>

*Madunić, J., & Sovulj, M. (2024). Application of ChatGPT in information literacy instructional design. *MDPI*, 12(11). <https://doi.org/10.3390/publications12020011>

*Malone, B. (2024). Ethical considerations in instructional design enhanced by artificial intelligence: A systematic literature review. *The Turkish Online Journal of Educational Technology*, 23(4).

*McNeill, L. (2024). Automation or innovation? A generative AI and instructional design snapshot. In *IAFOR International Conference on Education Proceedings* (pp. 187–194). IAFOR. <https://doi.org/10.22492/issn.2189-1036.2024.17>

Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research and Development*, 50(3), 43–59.

*Meron, Y., & Araci, Y. T. (2023). Artificial intelligence in design education: Evaluating ChatGPT as a virtual colleague for post-graduate course development. *Design Science*, 9, e30. <https://doi.org/10.1017/dsj.2023.28>

Online Learning Consortium. (2023). *Inspiring innovation: Instructional designers are leading the future of digital learning*. <https://onlinelearningconsortium.org/olc-insights/2023/09/online-learning-consortium-announces-2022-olc-innovate-award-winners-3/>

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *PLOS Medicine*, 18(3), e1003583. <https://doi.org/10.1371/journal.pmed.1003583>

*Pereira, E., Nsair, S., Radin Pereira, L., & Grant, K. (2024). Constructive alignment in a graduate-level project management course: An innovative framework using large language models. *International Journal of Educational Technology in Higher Education*, 21(25). <https://doi.org/10.1186/s41239-024-00457-2>

*Plumley, R. D., Bernacki, M. L., Greene, J. A., Kuhlmann, S., Raković, M., Urban, C. J., Hogan, K. A., Lee, C., Panter, A. T., & Gates, K. M. (2024). Co-designing enduring learning analytics prediction and support tools in undergraduate biology courses. *British Journal of Educational Technology*, 55(5), 1860–1883. <https://doi-org.libezp.lib.lsu.edu/10.1111/bjet.13472>

Qian, Y. (2025). Prompt engineering in education: A systematic review of approaches and educational applications. *Journal of Educational Computing Research*. <https://doi.org/10.1177/07356331251365189>

* Railean, E., Pavalachi, D., & Ceobanu, C. (2023). Educational metasytemology: AI's role in teacher training management. *Proceedings*

of the International Conference on Virtual Learning, 18, 147–158.
<https://doi.org/10.58503/icvl-v18y202312>

Reiser, R. A. (2001). A history of instructional design and technology: Part I: A history of instructional media. *Educational Technology Research and Development*, 49(1), 53–64.

*Rossi, R. (2021). Data science education based on ADDIE model and the EDISON framework. In *Proceedings of the International Conference on Big Data Engineering and Education* (pp. 40–45). IEEE.
<https://doi.org/10.1109/BDEE52938.2021.00013>

*Ruiz-Rojas, L. I., Acosta-Vargas, P., De-Moreta-Llovet, J., & Gonzalez-Rodriguez, M. (2023). Empowering education with generative AI tools: An approach with an instructional design matrix. *Sustainability*, 15(11524).
<https://doi.org/10.3390/su151511524>

*Sankaranarayanan, R., & Park, J. (2024). AI-driven instructional design: Ethical challenges and practical solutions. https://edtechbooks.org/applied_ethics_idt/AI_instructional_design_ethics

Siemens, G. (2004). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning*, 2(1). http://www.itdl.org/Journal/Jan_05/article01.htm

Skinner, B. F. (1958). *Verbal behavior*. Appleton-Century-Crofts.

*Stefaniak, J. E., & Moore, S. L. (2024). The use of generative AI to support inclusivity and design deliberation for online instruction. *Online Learning*, 28(3), 181–205. <https://doi.org/10.24059/olj.v28i3.4458>

Strauss, A., & Corbin, J. (1995). Grounded theory methodology: An overview. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 273–285). Sage.

Thomas, J., & Harden, A. (2008). Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Medical Research Methodology*, 8, 45. <https://doi.org/10.1186/1471-2288-8-45>

*Weber, N., Campbell, K., Bauer, H., & McCarthy, C. (2024). *Voices from the field: Current trends and challenges in instructional design and learning technology*. The Online Learning Consortium. <https://files.eric.ed.gov/fulltext/ED663936.pdf>

*Weng, X., Ye, H., Dai, Y., & Ng, O. (2024). Integrating artificial intelligence and computational thinking in educational contexts: A systematic review of instructional design and student learning outcomes. *Journal of Educational Computing Research*, 62(6), 1640–1670.
<https://doi.org/10.1177/07356331241248686>

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Appendix A Reviewed Articles by Year, Country, and AI Tool

Authors	Year	Country	AI Tools
Amado-Salvatierra et al.	2024	Guatemala	ChatGPT, DALLE-2, Heygen, Tome.ai, Play.ht, Overleaf
Bolick & da Silva	2024	US	ChatGPT, Midjourney, Descript
Chai et al.	2025	US	ChatGPT
Chang et al.	2024	Canada	ChatGPT
Ch'ng	2023	Malaysia	ChatGPT, DALL-E, GPT-based systems
Choi et al.	2024	US	ChatGPT, Midjourney, Adobe Firefly, Stable Diffusion, Synthesia, Murf AI, LALAL.AI
Conklin et al.	2024	US	ChatGPT
Czerkawski	2024	US	ChatGPT
DaCosta & Kinsell	2024	US	ChatGPT
Deng	2024	UK	Machine Learning Algorithms
Dickey & Bejaramo	2024	US	ChatGPT
Drugova et al.	2022	Russia	Machine Learning Algorithms, Intelligent Tutoring Systems, Recommender Systems
Edam	2024	Sudan	Intelligent Tutoring Systems, Adaptive Learning Systems, Natural Language Processing Tools
Fan et al.	2021	China	Learning Analytics Tools (Cluster Analysis, Process Mining, Epistemic Network Analysis)
Gazulla et al.	2023	Finland	EDUguia Chatbot
Hodges & Kirschner	2023	US	ChatGPT
Hu et al.	2024	China	GPT-4
Krushinskaia	2024	Belgium	ChatGPT, GPT-4 (Pre-trained on ID Model)
Kumar et al.	2024	US	ChatGPT, Microsoft Co-Pilot, Google Bard, DALL-E, Midjourney, Stable Diffusion, Descript, Eleven Labs, Otter AI, Grammarly
Leung et al.	2024	China/Hong Kong	None (AI discussed conceptually)

Authors	Year	Country	AI Tools
Liu et al.	2024	China	ERNIE Bot
Luo et al.	2024	US	ChatGPT, Microsoft Bing AI, Google Gemini, DALL-E, Midjourney, Descript, Perplexity AI, Claude, Education Copilot
Madunić & Sovulj	2024	Croatia	ChatGPT
Malone	2024	US	AI Tools (General Discussion, No Specific Tool Mentioned)
McNeill	2024	US	ChatGPT, Claude, Copilot, Bard, DALL-E
Meron & Araci	2023	Australia	ChatGPT
Pereira et al.	2024	Canada	ChatGPT
Plumley et al.	2024	US	Learning Analytics Tools, Explainable AI (XAI)
Railean et al.	2023	Moldova	Intelligent Tutoring Systems, Chatbots, Generative AI Tools, Intelligent Textbooks, Humanoid Robots
Rossi	2021	Brazil	EDISON Framework
Ruiz-Rojas et al.	2023	Ecuador	ChatGPT, Humata.ai, Fliki AI, Studio AI, You.com, Leonardo AI, ChatPDF
Sankaranarayanan & Park	2024	US	ChatGPT, Claude, Google Gemini, Copilot, DALL-E, Midjourney, Adobe Firefly, Descript
Stefaniak & Moore	2024	US	ChatGPT
Weber et al.	2024	US	ChatGPT, DALL-E, Midjourney, Descript, Eleven Labs
Weng et al.	2024	China/Hong Kong	Machine Learning Algorithms, Chatbots, Scratch, MIT App Inventor, AIoT Platforms