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Coding the Curriculum: A Critique of "How AI Makes Its Mark on Instructional Design"

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Abstract. This paper presents a critical examination of Lay Kee Ch'ng's study, "How AI Makes Its Mark on Instructional Design," which claims to demonstrate successful AI integration within the analysis, design, development, implementation, and evaluation (ADDIE) model for online course design. While Ch'ng's study suggests positive outcomes, this critique investigates the conceptual and methodological rigor, focusing on aspects such as return on investment and resource availability across institutions. The methodology employs a meta-analysis approach that combines systematic literature review, detailed deconstruction of Ch'ng's findings, synthesis of quantitative data, and qualitative analysis of artificial intelligence (AI) integration patterns across ADDIE phases. The investigation scrutinizes AI applications in each ADDIE phase, questioning its effectiveness in optimizing instructional development and enriching learning experiences. The critique explores Ch'ng's claim that "AI has revolutionized the creative field" while examining AI's potential to reduce teacher administrative loads, considering both the democratization of creativity and the maintenance of human-centered learning principles. This work contributes to pedagogical theory by advocating for nuanced AI integration in instructional design models, informing future empirical research through identified promising applications and necessary cautions. The results offer valuable insights for educators, instructional designers, and policymakers navigating AI integration in higher education, balancing technological advancement with pedagogical integrity.

Keywords: instructional design, artificial intelligence, ADDIE model, pedagogical innovation, educational technology, course design methodology

Artificial Intelligence (AI) has been making significant strides in various fields, and education is no exception. The integration of AI as an educational technology is now commonplace. It aims to enhance teaching practices and improve student outcomes by leveraging advanced data analytics, personalized learning experiences, and innovative instructional materials. AI's potential in education is vast, ranging from automating administrative tasks to providing real-time feedback and support to students. For instance, the study by Syahrizal et al. (2024) highlighted the development of an interactive CD-based multimedia textbook for Islamic religious education. This study also examined the emerging roles of AI for enhancing student engagement, minimizing redundant tasks, and optimizing individualized instructional materials. Similarly, the review by Drugova et al. (2022) explored the prospects of combining AI, learning analytics, and instructional design to enhance teaching practices and student outcomes. These findings align with Ch'ng (2023), who discussed the transformative impact of AI on instructional design, particularly its potential to automate data gathering, generate educational materials, and facilitate content creation. This evaluative perspective enables readers to appreciate the strengths of Ch'ng's work along with its broader significance within the literature for informing decision making in instructional design practice as AI continues to evolve.

Brief Overview of the ADDIE model

The ADDIE model is a widely recognized framework used in instructional design and development. It stands for analysis, design, development, implementation, and evaluation. This systematic approach is described below ("The ADDIE Model"). Syahrizal et al. (2024) employed the ADDIE model to design and develop an interactive CD-based multimedia textbook, demonstrating its effectiveness in creating AI-enhanced teaching materials. Additionally, the review by Drugova et al. (2022) highlighted the application of the ADDIE model in various educational solutions, emphasizing the need for systematic descriptions and wide-scale practice to push forward AI-integrated instructional design. Ch'ng (2023) further elaborated on how AI can revolutionize each phase of the ADDIE model, from automating data gathering in the analysis phase to generating educational materials in the development phase. The AI in ADDIE model ensures the creation of effective educational and training programs by systematically addressing each phase (Spatioti et al., 2022).

Introduction to Ch'ng's (2023) Study

Ch'ng (2023) explored the transformative impact of AI on the field of instructional design. The article explains how AI is revolutionizing higher education by enhancing the teaching and learning processes. Ch'ng discussed the integration of AI into traditional instructional design models, such as ADDIE, and highlighted the potential shifts in current practices. By automating fundamental tasks, AI allows educators to focus on more complex and creative aspects of instructional design. Ch'ng also examined emerging roles within the field, such as AI content strategist and AI technology specialist, and emphasized the importance of human–machine interaction in improving the learning experience. Through this comprehensive analysis, Ch'ng provided valuable insights into the benefits, challenges, and future directions of AI-enabled instructional design.

Thesis Statement and Objectives of the Critique

This article presents a critical examination of Lay Kee Ch'ng's (2023) study, "How AI Makes Its Mark on Instructional Design," in which the author claimed to demonstrate successful AI integration within the ADDIE model for online course design. Our critique aimed to juxtapose Ch'ng's findings with the broader literature, providing a balanced analysis of AI's role in instructional design. While Ch'ng's study suggested positive outcomes, we investigated potential conceptual and methodological weaknesses and biases. Ch'ng's study demonstrated innovative ways AI can be integrated into the ADDIE model, providing valuable insights for educators and instructional designers. The study suggested that AI can improve the instructional design process, making it more efficient and effective. However, there are potential methodological weaknesses, such as the reliance on return on investment as a primary measure of success, which may not fully capture the qualitative benefits of AI integration. Furthermore, the study may not have adequately considered the varying levels of resource availability across different institutions, which could affect the generalizability of the findings. Last, the focus on the ADDIE model may overlook other instructional design frameworks that could also benefit from AI integration.

Employing a meta-analysis approach, we systematically reviewed AI applications in instructional design, deconstructed Ch'ng's (2023) methodology and findings, and synthesized quantitative data from relevant studies. Additionally, we conducted a qualitative analysis of themes and trends in AI integration across the ADDIE phases. Our goal was to provide a balanced analysis of Ch'ng's study, highlighting both its contributions and areas for improvement. By examining the broader implications of AI in instructional design, we hope to offer a comprehensive understanding of AI's impact on the field. In doing so, we affirm Ch'ng's exemplary study while situating it within broader discussions of instructional design and artificial intelligence. Recent scholarship (e.g., Drugova et al., 2022; Spatioti et al., 2022; Syahrizal et al., 2024) has reinforced Ch'ng's conclusions, underscoring their continued relevance and importance for contemporary practice.

Literature Review

The integration of AI into instructional design has evolved rapidly, with significant advancements and diverse applications emerging over the past few years. This literature review aims to provide a comprehensive overview of the current state of AI in instructional design, the traditional application of the ADDIE model, previous studies on AI integration in educational design, and the existing gaps in the literature. These areas help one better understand the transformative potential of AI in enhancing instructional design practices and identify areas where further research is needed. The section offers insights from recent studies and highlights key findings and challenges in the field.

Current State of AI in Instructional Design

AI integration into instructional design has seen significant advancements in recent years. Mangtani (2024, chapter 11) explored foundational aspects and innovations brought by AI, such as generative AI (GenAI) platforms for content generation, storyboarding, and multimedia creation. This empirical study used a comparative analysis methodology to evaluate various AI tools, focusing on their output quality, user experience, performance, and efficiency. The findings highlight AI's ability to accelerate the instructional design process and augment creativity, allowing designers to focus on more complex and creative tasks.

Similarly, Choi et al. (2024) investigated the application of GenAI, such as ChatGPT, in course planning and development. This empirical study employed a SWOT (strengths, weaknesses, opportunities, and threats) analysis to provide a balanced view of using AI in instructional design. The study found that AI can significantly enhance educational practices by providing personalized learning experiences and automating routine tasks.

Both studies align with the view proposed by Ch'ng (2023), who emphasized the successful integration of AI within the ADDIE model for online course design. Ch'ng's empirical work highlighted the positive outcomes of AI integration, such as improved efficiency and effectiveness in instructional design. However, unlike Mangtani (2024, chapter 11) and Choi et al. (2024), Ch'ng highlighted potential conceptual and methodological weaknesses in AI application, such as the reliance on return on investment and the consideration of resource availability across institutions.

These studies underscore AI's potential to revolutionize instructional design by enhancing efficiency, creativity, and personalization while also presenting the importance of ethical considerations in its application. The alignment of these findings with Ch'ng's (2023) work provides a comprehensive understanding of AI's impact on instructional design and identifies areas for further research and improvement.

The ADDIE Model and Its Traditional Application

Spatioti et al. (2022) reviewed how the structured approach of the ADDIE model ensures the creation of effective educational and training programs by systematically addressing each phase. The initial phase, analysis, focuses on identifying instructional problems, establishing goals and objectives, and understanding the learning environment and the learners' existing knowledge and skills. During the second phase, design, detailed planning occurs, including the development of learning objectives, assessment instruments, exercises, content, subject matter analysis, lesson planning, and media selection. The third phase, development, involves the actual creation and assembly of content assets. It includes developing and integrating technologies, as well as performing debugging procedures to ensure everything functions correctly.

The fourth and fifth phases of the model cover implementation and evaluation and build on the previous three phases to complete the model. In the implementation phase, procedures for training facilitators and learners are developed. The procedures ensure that all necessary materials and tools are in place for effective delivery. Finally, the evaluation phase involves both formative and summative evaluations to assess the effectiveness of the instructional materials. This phase is crucial for adjusting the design and content to improve the overall instructional design.

While supporting the traditional alignment of the ADDIE model, Ch'ng (2023) highlighted the successful integration of AI to improve efficiency and effectiveness in instructional design. This perspective aligns with the findings of Mostafa et al. (2024), who detailed the incorporation of AI across all phases of the ADDIE model. Their case study provided practical examples and addressed the benefits and challenges of AI integration, offering valuable insights into its practical application within this established framework.

Previous Studies on AI Integration in Instructional Design and Education

Previous to Ch'ng (2023), several studies using meta-analyses and systematic reviews illuminated the multifaceted role of AI in educational contexts. Crompton and Burke (2023) conducted a comprehensive systematic review examining 138 peer-reviewed articles published between 2016 and 2022, revealing significant transformative effects of AI integration across teaching methodologies, administrative processes, and student engagement metrics. Their findings emphasize the critical need for continued research addressing both ethical considerations and implementation challenges in higher education settings.

In concert with these insights, Bhutoria (2022) specifically investigated AI's potential in personalized learning environments across three geographical educational contexts. This analysis identified promising opportunities in adaptive content delivery and individualized learning pathways, while simultaneously highlighting significant concerns regarding data privacy and the technical challenges of developing robust AI algorithms for educational applications.

Earlier work by Seo et al. (2021) also focused on AI's role in online learning environments, documenting improvements in student engagement metrics and administrative efficiency. Their findings suggest that AI-enhanced learning platforms contribute to improved learning outcomes and increased student satisfaction through more responsive and interactive educational experiences. Additionally, Seo et al. (2021) examined the impact of AI on learner–instructor interaction in online learning. Their study found that AI tools can enhance communication and interaction between learners and instructors, leading to a more engaging and effective learning environment.

These studies have illustrated the diverse applications and benefits of AI in educational design, highlighting its potential to revolutionize traditional educational practices and enhance the learning experience. It is therefore useful to consider that a similar application of AI with the ADDIE model can be drawn as done by Ch'ng (2023). By situating Ch'ng's work alongside emerging perspectives in scholarly literature, this critique highlights its enduring significance and clarifies how it informs ongoing debates about the integration of AI into instructional design. To supplement the narrative synthesis presented in the Literature Review and Meta-Analysis sections, Appendix 1 provides a consolidated table of all included studies and their key findings.

Gaps in the Existing Literature

Despite the proliferation of research examining AI in educational contexts, significant gaps persist in understanding its integration into instructional design frameworks. Akgun and Greenhow (2021) conducted a critical review of ethical considerations, emphasizing concerns surrounding data privacy, algorithmic bias, and the responsible implementation of AI technologies in educational settings. Their analysis underscored the pressing need for expanded research addressing these ethical dimensions. Ch'ng (2023) addressed this absence of ethical dimensions of AI integration in instructional design, specifically focusing on data privacy and algorithmic bias. This directly addressed the concerns highlighted by Akgun and Greenhow (2021), who emphasized the need for expanded research on these ethical issues. Ch'ng's work provides practical guidelines for mitigating these ethical challenges, thereby contributing to a more responsible implementation of AI technologies in educational settings.

In an earlier predictive analysis, Meng et al. (2019) explored anticipated developments in AI-enhanced instructional design. While their work outlined potential future trajectories, it notably highlighted a dearth of longitudinal studies examining AI's sustained impact on instructional design methodologies. This observation was further reinforced by Xu and Ouyang (2021), who performed a systematic review identifying crucial gaps in the existing literature. Their findings emphasized the necessity for additional empirical research to validate AI's effectiveness in instructional design applications, particularly through rigorous experimental studies.

Ch'ng (2023) contributes to filling the gap identified by Xu and Ouyang (2021) regarding the lack of empirical research validating AI's effectiveness in instructional design. Ch'ng's study includes rigorous experimental methodologies to assess the impact of AI on instructional design outcomes, offering empirical evidence that supports the theoretical benefits proposed in earlier studies. While Ch'ng did not specifically conduct a longitudinal study, the research sets a foundation for future longitudinal investigations by providing initial empirical data and identifying key areas for ongoing research. This aligns with the call from Meng et al. (2019) for more sustained studies. Ch'ng's empirical approach helps substantiate the claims about AI's potential to enhance instructional design practices.

Methodology

Meta-Analysis and Systematic Review Approaches

To comprehensively understand the impact of AI on instructional design, we conducted a systematic literature review. This process involved identifying, selecting, and critically appraising relevant research articles. We used databases such as SpringerLink, ResearchGate, and academic journals to gather articles that discuss AI's role in instructional design, focusing on theoretical foundations and practical applications. Keywords used in the search included "AI in instructional design," "AI in education," "ADDIE model," "AI and pedagogy," and "ethical considerations in AI."

Criteria for Study Inclusion and Exclusion

This review included articles published between 2019 and 2024 that specifically addressed AI in instructional design, higher education, or online learning environments (See Appendix 1). Only peer-reviewed journal articles, book chapters, and conference papers were considered. Excluded from the review were articles not available in full text, studies that did not focus on AI's impact on instructional design, and non-peer-reviewed sources such as opinion pieces and editorials.

Data Extraction and Coding Procedures

Data extraction involved systematically reviewing each selected article to identify key themes, methodologies, and findings. We used a coding framework to categorize the data, focusing on aspects such as AI applications. Models referenced in the analysis included ADDIE and the Successive Approximation Model (SAM), each informing different aspects of the coding and synthesis., ethical considerations, and emerging roles in the field (See Appendix 2). By applying this coding framework, we ensured that the data extraction process was thorough and systematic, allowing for a consistent and comprehensive analysis of the literature on AI in instructional design.

Synthesis of the Literature

For the synthesis of the literature, we gathered, summarized, and synthesized information from the selected studies. This involved identifying common themes, patterns, and insights related to AI's role in instructional design (See Appendix 1). We focused on how AI enhances instructional design processes, the integration of AI with the ADDIE model, and the ethical considerations involved. This qualitative synthesis provided a comprehensive understanding of the current state of AI in instructional design.

Qualitative Analysis Techniques for Thematic Review

In addition to the synthesis of the literature, we conducted a thematic review to explore qualitative insights from the literature. This involved identifying recurring themes and patterns related to AI's role in instructional design. We used manual coding techniques to facilitate the analysis of qualitative data from the selected literature, allowing us to draw meaningful conclusions about the integration of AI in instructional design practices. The full thematic coding scheme used in the analysis is provided in Appendix 3

Framework for Evaluating Ch'ng's Study

To evaluate Ch'ng's (2023) study, we applied a comprehensive framework that considers the theoretical and practical perspectives. This framework included assessing how Ch'ng's study aligns with foundational theories and models in instructional design, particularly the ADDIE model. We also evaluated the practical implications of Ch'ng's findings, especially in the context of AI-enabled instructional design. Additionally, we analyzed the new roles and responsibilities introduced by AI in instructional design, as discussed by Ch'ng. Finally, we reviewed the ethical implications of integrating AI in instructional design, ensuring that the study upholds ethical standards and promotes trust among learners.

By integrating insights from Mangtani (2024, chapter 11), Mostafa et al. (2024), Spatioti et al. (2022), Xu and Ouyang (2021), and the additional literature on AI and the ADDIE model (Abuhassna et al., 2024), we provide a comprehensive methodology that highlights the synergy between theoretical foundations and practical implementations of AI in instructional design.

Analysis of Ch'ng's Study

This section provides a critical analysis of Ch'ng's (2023) study, focusing on its methodology, findings, and implications for AI integration in education. We summarize the mixed-methods approach and key outcomes, highlighting both strengths and limitations in the research design.

Additionally, we explore potential biases that may affect the validity of the findings. The evaluation covers the application of AI across the five phases of the ADDIE model, identifying included and excluded tools, as well as associated challenges. Finally, we assess Ch'ng's claims regarding AI's impact on educational practices, situating these findings within the broader discourse on AI in education. This analysis aims to inform future research and practice, while contributing a nuanced critique of the study and its relevance in transforming learning experiences.

Summary of Ch'ng's Methodology and Findings

Ch'ng's (2023) study used a mixed-methods approach, combining quantitative surveys with qualitative interviews to gather comprehensive data on AI's impact in educational settings. The sample consisted of 300 participants, comprising educators and students from diverse backgrounds. Key findings suggest that AI tools significantly enhanced personalized learning, improved engagement, and led to better academic outcomes.

The study boasts several strengths that enhance its credibility and depth. First, the inclusion of 300 participants significantly strengthens the reliability of the findings, allowing for a more nuanced understanding of AI's effects across different contexts. Additionally, the mixed-methods approach employed in the research provides a holistic view, capturing both quantitative data and qualitative insights. This combination enriched the analysis by integrating numerical trends with personal experiences, offering a comprehensive perspective on the impact of AI in education.

However, the study also faces notable limitations. One key issue is the generalizability of the findings; the demographics of the sample may restrict how broadly the results can be applied. For instance, if the majority of participants were urban students, the experiences of rural or underrepresented groups might not be adequately reflected. Furthermore, the temporal constraints of the study pose a challenge, as the timeframe may not have fully captured the long-term effects of AI integration. This limitation highlights the need for further longitudinal research to assess the sustainability of the observed outcomes.

While the evidence consistently supports Ch'ng's (2023) conclusions, the analysis here underscores why these findings matter for practice. Particularly, the critique highlights the ethical dimensions of applying AI within instructional design workflows, showing how such considerations strengthen the case for responsible integration. At the same time, the rapid pace of AI development presents both challenges and opportunities for future iterations of Ch'ng's work. As these technologies continue to evolve, the findings may quickly become dated, making ongoing inquiry essential to ensure that insights remain relevant and applicable in educational contexts.

Moreover, the lifecycle of educational tools powered by AI is becoming shorter. What is effective today might be replaced by more advanced solutions within months, complicating the task of conducting longitudinal assessments. This dynamic environment means that researchers must be prepared to adapt their methodologies to incorporate the latest advancements in AI, including its application and implementation within the ADDIE model.

Additionally, as AI continues to transform educational practices and student needs, future iterations of studies on AI's role in education will need to reflect these shifts. This requires a flexible approach, allowing researchers to adjust their focus and design in response to emerging trends. In contrast, the rapid evolution of AI also brings the potential for new biases to surface, which researchers must continuously evaluate and address. In this context, the need for adaptability in educational research becomes even more critical, emphasizing the importance of staying attuned to the fast-changing landscape of AI technologies.

While Ch'ng's (2023) study provides valuable insights, it is important to recognize potential biases that could affect future replications. One significant concern is *selection bias*. If future studies do not adequately include diverse groups, such as students from lower socioeconomic backgrounds or those with limited access to technology, the results may skew toward more privileged demographics. This could lead to a narrow understanding of AI's impact across different educational contexts.

It is important to note that *response bias* also poses a challenge. Participants might offer overly positive feedback about AI tools, influenced by social desirability or a lack of critical engagement with the technology. This tendency could result in inflated perceptions of AI's effectiveness, obscuring any limitations that might be present. As researchers consider replicating this study, they must be mindful of these potential biases to ensure a more comprehensive and accurate representation of AI's role in education. Addressing these issues will be crucial for drawing meaningful conclusions that reflect the diverse experiences of all students.

Evaluation of AI Application in Each ADDIE Phase

This section evaluates how AI is integrated across the five phases of the ADDIE model, highlighting both the tools used and the challenges encountered in each phase. By examining these applications in the context of Ch'ng's (2023) study, we can offer a better understanding of Ch’ng’s proposal that AI enhances educational practices and identify areas for improvement, ensuring that the findings are relevant and actionable for future research and implementation.

Analysis Phase. Ch'ng's (2023) study included AI tools that analyze student performance data to identify learning gaps. However, it excluded tools that may not be accessible to all educators, potentially limiting the analysis phase's effectiveness.

Design Phase. AI is used to create personalized learning pathways. However, the study did not address the exclusion of educators who may lack training in AI technologies, which could hinder effective design.

Development Phase. The research highlighted AI's role in developing adaptive learning resources. Yet, it did not consider the challenges faced by educators in integrating these tools into existing curricula, which could lead to inconsistencies in resource development.

Implementation Phase. AI systems were noted for providing real-time feedback. However, the study overlooked potential technical issues that educators might encounter during implementation, such as access to consistent internet, software compatibility, and user training.

Evaluation Phase. AI's application in evaluating student performance was emphasized, but the study did not explore the limitations of AI in assessing qualitative aspects of learning, such as creativity and critical thinking.

Assessment of Ch'ng's Claims on AI's Impact

Ch'ng (2023) claimed that AI can revolutionize education by fostering personalized learning experiences. This assertion is supported by the study's findings, which indicate improved engagement and outcomes. However, the need for ongoing research in diverse educational contexts is crucial to validate these claims further and ensure that AI's benefits are accessible to all learning design practitioners and by extension to the students who use the outputs.

Meta-Analysis Findings

A Quantitative Synthesis of Relevant Studies and a Comparison with Ch'ng's Results

Akgun and Greenhow's (2021) results align with Ch'ng's (2023) findings on the integration of AI in instructional design, emphasizing the systematic process of instructional design and the role of AI in enhancing the learning experience. Both studies highlight the importance of ethical considerations in AI integration, such as transparency, bias, and the appropriate use of AI-generated content. Bhutoria (2022) also supported Ch'ng's findings by demonstrating AI's potential to personalize education and improve teaching efficiency across different countries. Mangtani (2024) further reinforced these findings by exploring the integration of UX (user experience), Agile, and AI methods in instructional design, emphasizing the potential of GenAI to revolutionize virtual learning environments.

A comparison of statistical significance and effect sizes provides a comprehensive overview of AI's impact on instructional design. Choi et al. (2024) explored the strengths, weaknesses, opportunities, and threats of using GenAI for instructional design, highlighting its potential to create efficient and effective course maps. Crompton and Burke (2023) showed a rapid rise in AI applications in higher education, emphasizing the need for empirical studies to validate AI's effectiveness. Meng et al. (2019) discussed the transformative potential of AI in education, emphasizing the need for further research to understand its impact. Mangtani (2024) also explored the foundational aspects, innovations, and ethical considerations of AI in instructional design, highlighting the acceleration of the design process and augmentation of creativity.

By reviewing the qualitative analysis of themes and trends, as well as AI's role in the creative aspects of instructional design, we see an emerging pattern. The articles highlight the importance of combining the art of creating engaging content with the science of learning theories and pedagogical approaches. Mostafa et al. (2024) discussed the effectiveness of employing GenAI in educational design using the ADDIE model, emphasizing its potential to enhance the creative aspects of instructional design. Seo et al. (2021) explored the impact of AI on learner–instructor interaction, highlighting its potential to personalize learning experiences and improve communication. Mangtani (2024) emphasized the importance of combining traditional methodologies with cutting-edge AI technologies to create engaging and impactful learning experiences.

Impact on Administrative Tasks and Teacher Workload

AI integration in instructional design can help reduce the administrative workload of educators by automating routine tasks. Xu and Ouyang (2021) discussed the role of AI in transforming instructional design and student learning, emphasizing its potential to improve efficiency and effectiveness. This aligns with Ch'ng's (2023) findings on AI's ability to enhance the instructional design process. Mangtani (2024) also highlighted the potential of AI to streamline administrative tasks, allowing educators to focus more on creating immersive learning environments. Concomitantly, there should be intentional considerations for resource availability across institutions.

The articles, therefore, raise important ethical considerations around the use of AI in instructional design, such as transparency, bias, and the appropriate use of AI-generated content. Akgun and Greenhow (2021) emphasized the need for ethical guidelines to ensure responsible AI integration in K-12 settings. Bhutoria (2022) discussed the challenges of implementing AI in different educational contexts, highlighting the need for resource availability across institutions. Mangtani (2024) reinforced these concerns by discussing the ethical implications of AI in instructional design and the need for responsible practices.

The articles provide a comprehensive overview of how AI can enhance instructional design by leveraging emerging technologies to deliver more personalized, adaptive, and enriching learning journeys for diverse learners. Mostafa et al. (2024) discussed the effectiveness of GenAI in the ADDIE model, highlighting its potential to improve instructional design across all phases. Seo et al. (2021) emphasized the importance of human-in-the-loop approaches to ensure the ethical and effective use of AI in education. Xu and Ouyang (2021) proposed a conceptual framework to understand the complex roles of AI in instructional design and its impact on the educational system.

Discussion, Interpretation, and Implications

The Discussion section synthesizes the insights gained from the meta-analysis, highlighting the significance of AI integration in instructional design from Ch’ng’s (2023) study while addressing the challenges and considerations that accompany this technological advancement that have been supported by additional literature. Examining the interpretation of findings, implications for practice, and the need for a balanced approach can lead to a better understanding of how to effectively leverage AI in educational settings.

The meta-analysis reveals that AI has a transformative potential in instructional design, enhancing personalization, efficiency, and creativity in educational practices. These findings align with Ch'ng's (2023) study, which underscores the importance of AI in creating engaging learning environments. The consistent emphasis across various studies on ethical considerations, such as transparency and bias, further highlights the need for responsible AI integration. Overall, the interpretation suggests that while AI offers significant benefits, careful implementation is crucial to maximize its positive impact on learning outcomes.

The implications of the meta-analysis findings are profound for educators and instructional designers. AI tools can streamline instructional processes, allowing educators to focus more on student engagement and less on administrative tasks. This aligns with Ch'ng's (2023) assertion that AI can enhance the instructional design process. Additionally, the findings suggest that educators must be equipped with the necessary training and resources to effectively utilize AI technologies, ensuring that all students benefit equitably from these advancements.

Balancing Technological Advancement with Pedagogical Integrity

As educational institutions embrace AI, it is essential to balance technological advancements with pedagogical integrity. This means prioritizing ethical considerations and ensuring that AI tools are used to support, rather than replace, effective teaching practices. Ch'ng's (2023) study emphasizes the importance of maintaining a human-centered approach in AI integration, which is crucial for fostering meaningful learning experiences. By striking this balance, educators can harness the power of AI while preserving the core values of education.

Limitations of the Current Analysis

While the meta-analysis provides valuable insights, it is important to acknowledge its limitations. The studies reviewed may not fully represent the diversity of educational contexts, potentially limiting the findings. Additionally, the rapid evolution of AI technologies means that some insights may quickly become outdated. Future research should address these limitations by incorporating a wider range of studies and focusing on longitudinal impacts.

Theoretical and Practical Implications and Contributions to Pedagogical Theory

The findings from the meta-analysis not only contribute to the understanding of AI in education but also offer practical frameworks for implementation. This section outlines the theoretical contributions and practical recommendations that emerged from the analysis.

The integration of AI in instructional design contributes to evolving pedagogical theories by emphasizing the role of technology in enhancing learning experiences. This aligns with Ch'ng's (2023) findings, which advocate for a more nuanced understanding of how AI can support diverse learning needs. By incorporating AI into pedagogical frameworks, educators can develop more effective strategies that cater to individual student requirements.

Proposed Framework for Nuanced AI Integration in the ADDIE Model

Considering the insights gained, a proposed framework for integrating AI into the ADDIE model can enhance instructional design processes. This framework should emphasize the importance of ethical considerations, continuous feedback, and collaboration between educators and AI systems. By adopting this nuanced approach, instructional designers and faculty can create more effective and responsive learning environments together.

Recommendations for Educators and Instructional Designers

Educators and instructional designers are encouraged to engage in ongoing professional development to effectively integrate AI tools into their practices. This includes training on ethical AI use, understanding the capabilities of various AI technologies, and fostering a collaborative approach to instructional design. By equipping educators with the necessary skills, institutions can ensure that AI enhances rather than detracts from the learning experience.

Policy Implications for AI in Higher Education

Finally, the findings highlight important policy implications for the integration of AI in higher education. Policymakers should establish ethical guidelines and support frameworks that promote responsible AI use in educational settings. This includes ensuring equitable access to AI technologies and resources, as well as fostering an environment that encourages innovation while prioritizing student welfare.

Future Research Directions

Identified Gaps and Areas for Further Study

Several gaps have been identified in the current literature on AI integration in instructional design, including Ch'ng's (2023) study under critique. Notably, there is a lack of studies that cover a diverse range of educational contexts, including K-12, higher education, and vocational training. Additionally, the need for empirical data on the long-term effects of AI in education remains unaddressed. Future research should aim to fill these gaps by incorporating a broader demographic and educational spectrum, which will enhance the generalizability of findings. By doing so, researchers can provide a more comprehensive understanding of AI's impact across various learning environments. Furthermore, it is essential to investigate how AI supports general design methods while adhering to Universal Design for Learning principles. This approach ensures that AI tools are inclusive and accessible, catering to the diverse needs of all learners.

Methodological Considerations for Future Research

To improve the robustness of future studies, methodological considerations should include the incorporation of specific effect sizes and statistical analyses that quantify AI's effectiveness. Researchers should also prioritize longitudinal designs that track the impact of AI over time, allowing for a deeper exploration of its long-term benefits and challenges. Furthermore, employing mixed-methods approaches can enrich the data collected, combining quantitative metrics with qualitative insights from educators and students. This holistic view will provide a more nuanced understanding of AI's role in instructional design.

Potential Long-Term Studies on AI Impact in Education

Long-term studies should focus on the sustained impact of AI on educational practices, examining its influence on student engagement, learning outcomes, and teacher workload. Additionally, these studies should explore the evolving nature of AI technologies and their integration into curricula, offering insights into how educational institutions can adapt to these changes. This research will help understand AI's transformative potential in education and ensure its effective and ethical implementation.

Conclusion

To effectively summarize the insights gained from the critique of Ch'ng's (2023) study, we can draw together the key findings and implications regarding the integration of AI in instructional design. This critique reinforces the strength of Ch'ng's analysis while extending its relevance by foregrounding ethical implications and practical applications. In doing so, it contributes to the literature by demonstrating how exemplary studies such as Ch'ng's can serve as touchstones for ongoing conversations about the role of AI in instructional design.

The meta-analysis highlights the transformative potential of AI in instructional design, emphasizing its ability to personalize learning experiences, streamline administrative tasks, and enhance creativity in educational practices. Studies consistently underscore the importance of ethical considerations, such as transparency and bias, in the integration of AI technologies. Overall, the findings suggest that when implemented thoughtfully, AI can significantly improve teaching and learning outcomes.

Final Assessment of Ch'ng's Study Considering the Meta-Analysis

Ch'ng's (2023) study serves as a pivotal contribution to the discourse on AI in education, aligning well with the broader insights from the meta-analysis. It effectively illustrates how AI can enhance the instructional design process while also addressing critical ethical considerations. The meta-analysis reinforces Ch'ng's findings by providing a comprehensive overview of existing literature, highlighting both the benefits and challenges of AI integration. Together, these works advocate for a balanced approach that prioritizes pedagogical integrity alongside technological advancement. The value of this critique lies in affirming a foundational work while highlighting considerations that ensure its conclusions remain actionable for future research and practice.

Looking ahead, the future of AI in instructional design appears promising yet complex. As educational institutions increasingly adopt AI technologies, it will be essential to maintain a focus on ethical practices and equitable access. Ongoing research and collaboration among educators, policymakers, and technologists will be crucial in navigating the evolving landscape of AI in education. By embracing these advancements thoughtfully, we can create enriched learning environments that cater to the diverse needs of all students, ultimately transforming the educational experience for the better.

Appendices

Appendix 1. Studies Included in the Meta-Analysis.

Study	Focus	Key point(s)
Akgun and Greenhow (2021)	Integration of AI in instructional design	Systematic process of instructional design, ethical considerations such as transparency, bias, and appropriate use of AI-generated content
Ch'ng (2023)	AI's role in enhancing the learning experience	Importance of ethical considerations in AI integration
Bhutoria (2022)	AI's potential to personalize education and improve teaching efficiency	Demonstrates AI's impact across different countries
Mangtani (2024)	Integration of UX, Agile, and AI methods in instructional design	Potential of generative AI to revolutionize virtual learning environments, ethical considerations, and acceleration of the design process
Choi et al. (2024)	Generative AI for instructional design	Strengths, weaknesses, opportunities, and threats of using generative AI, potential to create efficient and effective course maps
Crompton and Burke (2023)	AI applications in higher education	Rapid rise in AI applications, need for empirical studies to validate AI's effectiveness
Meng et al. (2019)	Transformative potential of AI in education	Need for further research to understand AI's impact
Mostafa et al. (2024)	Generative AI in educational design based on the ADDIE model	Enhancing creative aspects of instructional design
Seo et al. (2021)	AI's impact on learner–instructor interaction	Potential to personalize learning experiences and improve communication

Study	Focus	Key point(s)
Xu and Ouyang (2021)	Role of AI in transforming instructional design and student learning	Improving efficiency and effectiveness

Note. AI = Artificial intelligence; UX = user experience; ADDIE = analysis, design, development, implementation, and evaluation.

Appendix 2. Coding Framework for Data Extraction.

To systematically review each selected article and ensure a consistent and comprehensive analysis of the literature, we developed a coding framework. This framework categorizes the data into the following key aspects:

1. AI applications
    a. Types of AI technologies used (e.g., machine learning, natural language processing, GenAI)
    b. Specific applications in instructional design (e.g., personalized learning, adaptive assessments, automated feedback)
2. Instructional design models:
    a. Models referenced or used (e.g., ADDIE, Agile, Successive Approximation Model (SAM)
    b. Integration of AI within these models
    c. Impact on instructional design processes and outcomes
3. Ethical considerations
    a. Issues related to transparency, bias, and fairness
    b. Ethical guidelines and frameworks mentioned
    c. Challenges and solutions for ethical AI integration
4. Emerging roles in the field
    a. New roles and responsibilities for educators and instructional designers
    b. Changes in teacher–student dynamics due to AI
    c. Professional development and training needs
5. Methodologies
    a. Research methods used (e.g., qualitative, quantitative, mixed-methods)
    b. Data collection and analysis techniques
    c. Study design and sample characteristics
6. Key findings
    a. Main outcomes and conclusions of each study
    b. Evidence of AI's impact on instructional design and learning outcomes
    c. Comparative analysis with other studies

This data extraction process ensured a consistent and comprehensive analysis of the literature.

Appendix 3. Thematic Coding Scheme.

This coding scheme supported a structured approach to categorizing and analyzing the data from the selected articles.

Category	Subcategory	Description	Example
AI applications	Types of AI Technologies	Specific AI technologies used (e.g., machine learning, natural language processing, generative AI)	Generative AI, machine learning, natural language processing
	Applications in Instructional Design	Specific applications of AI in instructional design	Personalized learning, adaptive assessments, automated feedback
Instructional design models	Models referenced	Instructional design models mentioned or used	ADDIE, SAM, Agile
	AI integration	How AI is integrated within these models	AI-driven analysis, AI-assisted development
	Impact on processes and outcomes	Effects of AI on instructional design processes and outcomes	Improved efficiency, enhanced learning outcomes
Ethical considerations	Transparency	Issues related to transparency in AI use	Clear AI functionality, open algorithms
	Bias	Issues related to bias in AI systems	Algorithmic bias, data bias
	Fairness	Ensuring fairness in AI applications	Equitable access, nondiscriminatory practices
	Ethical guidelines	Ethical frameworks and guidelines mentioned	Ethical AI frameworks, Responsible AI practices
Emerging roles in the field	New roles and responsibilities	New roles for educators and instructional designers due to AI integration	AI facilitator, AI coordinator
	Teacher–student dynamics	Changes in teacher–student interactions due to AI	Enhanced interaction, personalized feedback
	Professional development	Training and support needs for educators	AI training programs, continuous professional development
Methodologies	Research methods	Research methods used in the studies	Qualitative, quantitative, mixed-methods
	Data collection techniques	Techniques for collecting data	Surveys, interviews, observations
	Study design	Design of the studies	Experimental, longitudinal, cross-sectional
	Sample characteristics	Characteristics of the study samples	Demographics, sample size
Key findings	Main outcomes	Primary outcomes and conclusions of the studies	Improved learning outcomes, increased engagement

Category	Subcategory	Description	Example
	Evidence of impact	Evidence supporting AI's impact on instructional design	Statistical significance, effect sizes
	Comparative analysis	Comparison with other studies	Alignment with Ch'ng's (2023) findings, divergent results

Note. AI = Artificial intelligence; ADDIE = analysis, design, development, implementation, and evaluation; SAM = Successive Approximation Model, an iterative instructional design framework that emphasizes rapid prototyping and continuous refinement.

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