Lecture Notes on Data Engineering and Communications Technologies 262

Rubén González Vallejo
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The Second International Symposium on Generative AI and Education (ISGAIE'2025)

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Editors

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ISGAIE'2025 Preface

This volume constitutes the refereed proceedings of the Second International Symposium on Generative AI and Education (ISGAIE'2025), held in Málaga, Spain, on May 15–16, 2025. The symposium is an international and interdisciplinary conference co-organized by the University of Málaga (Spain) and Hassan II University of Casablanca (Morocco). It brings together researchers, practitioners, and educators to present and discuss the latest advances in the development and application of generative artificial intelligence in educational contexts.

The ISGAIE'2025 conference brought together a diverse array of perspectives exploring how generative artificial intelligence (GenAI) is transforming education. Discussions focused on recent advancements in AI technologies and their emerging impact on teaching and learning practices. A central theme was the evolution of pedagogical methods to align with the demands and opportunities of the AI era.

Participants examined the integration of GenAI in both in-person and online learning environments. These technologies are enabling more flexible instructional models, fostering personalized learning experiences, and introducing innovative approaches to student assessment. Several contributions highlighted the use of GenAI in teacher training, the development of virtual teaching assistants, and the provision of automated feedback aimed at enhancing learner engagement and academic support.

In response to the call for papers for ISGAIE'2025, we received a total of 157 submissions from 18 countries. Each submission went through a careful peer-review process carried out by members of the technical program committee and additional expert reviewers. The reviews offered detailed feedback on the quality and relevance of the papers. Based on these evaluations, 40 papers were selected for presentation as full papers, resulting in an acceptance rate of 25.5%.

This volume is organized into six thematic parts, each corresponding to a major session of the symposium, reflecting key dimensions of Generative AI in education:

Part I: Generative AI in Education – An Overview
Part II: Personalized Learning and Intelligent Tutoring with Generative AI
Part III: Generative AI in Specialized Educational Contexts
Part IV: Generative AI for Educational Assessment
Part V: Case Studies and Practical Applications of Generative AI in Education
Part VI: Ethical Considerations and Responsible Use of Generative AI

Finally, we want to take this opportunity to express our sincere thanks to the contributors to this volume and the reviewers for their outstanding efforts in reviewing and providing interesting feedback to the authors of the chapters. The editors would like to thank Mr. Thomas Ditzinger (Series Editor-in-Chief) and Ms. Sylvia Schneider (Springer Project Coordinator), for the editorial assistance and support to produce this

important scientific work. Without this collective effort, this book would not have been possible to be completed.

Rubén González Vallejo

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Dr. Vasileios Paliktzoglou, an academic and industry professional, holds a Ph.D. in Computer Science from the University of Eastern Finland. He is an active contributor to academia, serving as a guest and associate editor for prestigious journals like the Journal of Information Systems Education (JISE) and IAFOR Journal of Education. He has been

a keynote speaker at several academic and industry events, sharing his insights on social computing, collaborative learning, and emerging technologies in higher education. Dr. Paliktzoglou also actively participates in international research projects, highlighting his commitment to advancing knowledge and innovation. As Book Series Editor for Emerging Technologies in Education at Vernon Press and AI and Education at STAR Scholars Press, he continues to shape academic discourse. Additionally, he has taken on significant leadership roles, serving as Conference Chair and Publication Chair for various international conferences. His expertise continues to influence the academic and research landscape at Bahrain Polytechnic.

Generative AI in Education: An Overview

Toward a New Instructional Design Methodology in the Era of Generative AI

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Abstract. Recent advances in generative artificial intelligence (AI) are transforming the way we learn and design training by integrating it into the practices of teachers and students. However, the effective integration of AI requires considering the limitations of existing frameworks. Despite their effectiveness, traditional models such as ADDIE and SAM have limitations such as restricted customization, long design cycles, and limited flexibility. These barriers make it difficult to use them in dynamic and adaptive educational scenarios. This article proposes a new instructional design model integrating generative AI, resulting from an exploratory survey of instructional designers, teachers, and trainers to identify their interest and readiness for using IA. The insights captured from our survey underscore a significant inclination towards AI-driven automation and emphasize the need for human collaboration and oversight to ensure pedagogical relevance. Our model revisits ADDIE phases by leveraging these results. Key contributions include a structured way to integrate AI in the design process, a human-AI collaboration framework, and iterative evaluation mechanisms. In addition to filling existing gaps in instructional design, this study opens the door for adaptive, AI-enhanced learning experiences. Empirical validation in actual educational environments will be the focus of future research.

Keywords: Generative AI · Instructional Design · Pedagogical Frameworks

1 Introduction

Contemporary education is undergoing a period of rapid transformation driven by emerging technologies, and in particular generative artificial intelligence (AI). Tools like ChatGPT, DALL-E, Napkin AI, and other sophisticated models assist in creating textual content, images, and videos that assist trainers and instructional designers by automating their daily pedagogical tasks. Students use the content generated by these tools, while the tools themselves serve as tutors or assist with their pedagogical activities. AI integration needs to be structured to ensure it transforms education in a constructive and efficient manner, as mentioned in the article [1], The integration of technologies into pedagogical models, such as the ADDIE model, demonstrates significant potential for enriching educational practices.

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Even though generative AI tools are becoming more and more popular in education, there is still a big lack of systematic integration into well-established instructional design frameworks [2]. Specifically, traditional models like ADDIE—although effective—lack mechanisms to leverage the personalization potential of AI, agile workflows to reduce design cycles, and structured human-AI collaboration protocols. To address these shortcomings, our study presents ADGIE, a sophisticated framework that: integrates AI into each step of ADDIE (Analysis-Evaluation); automates repetitive tasks under human supervision; and uses iterative validation loops to reduce development time. This bridges the gap between technological innovation and pedagogical reliability, offering educators a validated path for the adoption of AI.

We examined the limitations of the ADDIE model considering current educational issues, specifically with regard to technology integration and personalized learning. Additionally, through a survey, we determine the areas in which instructional designers and trainers must incorporate generative AI into their process of creating learning materials and their preparedness to use AI as a tool.

In light of this, we propose a conceptual reflection on the adaptation of the different phases of the ADDIE model through the integration of generative AI tools.

This article stands out from existing research by adopting a comprehensive, structured approach that examines how generative AI can be integrated into all phases of the ADDIE model. Unlike other studies that often focus on benefits for learners or the automation of pedagogical tasks, our research stands out by exploring the concrete integration of generative AI into teaching practices. We analyze how teachers can appropriate these technologies to enrich their pedagogy. The aim is to identify the opportunities and potential impacts of this integration for improving pedagogical practices, reducing design cycles and supporting the personalization of learning.

This article is structured in several sections. A literature review examines related research on the ADDIE model and applications of generative AI in education, highlighting the current limitations of traditional approaches. Next, we present our methodology, followed by a proposed conceptual model detailing how generative AI can be integrated into each phase of the ADDIE model to improve pedagogical effectiveness. An in-depth analysis explores the opportunities and potential impacts of this integration, while discussing the limitations and challenges associated with its application. The article concludes with a synthesis of the results and avenues for future research.

2 Related Work

This section reviews previous work on the use of the ADDIE model in instructional design, as well as on the integration of generative artificial intelligence in educational environments. By identifying the strengths and limitations of these approaches, we contextualize the relevance of our proposal. In particular, we explore how the ADDIE model can be enriched by modern technological approaches, notably the integration of generative artificial intelligence, to transform educational practices.

2.1 ADDIE Model

The ADDIE model is a widely recognized framework for instructional design, valued for its simplicity and flexibility. This systematic and generic model adapts to a variety of educational contexts and is structured in five phases: Analysis, Design, Development, Implementation, and Evaluation [3]. The ADDIE model stands out for its ability to provide a robust and structured framework for effectively designing, implementing, and evaluating educational programs (see Fig. 1).

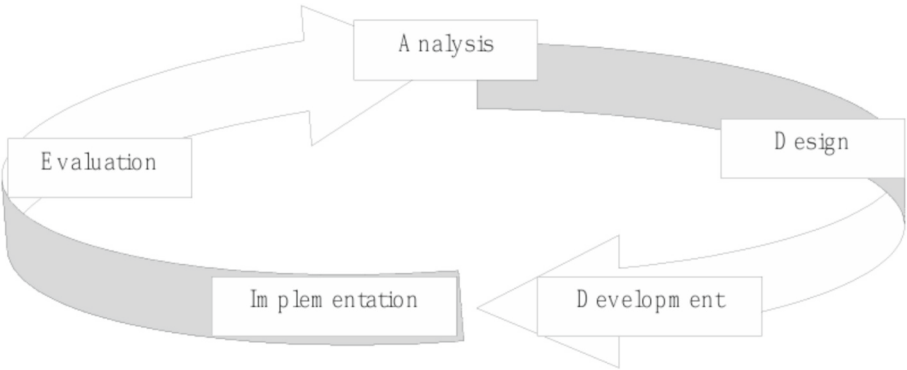

Fig. 1. The five phases of the ADDIE model

Analysis. The first step is to analyze the learning needs. What specific knowledge and skills do learners have to acquire? What is their current level of prior knowledge? What are their individual learning preferences? It is also essential to consider how the module will be delivered and what resources are available to ensure an effective and engaging transfer of knowledge.

Design. The second phase is design. It includes the definition of precise and relevant learning objectives. What are the learning objectives? What teaching methods will be used to support these objectives? How do the defined objectives align with the overall learning objectives?

Development. The third phase is development. It focuses on selecting or designing the learning environment that best fits the training context and supports effective learning. What is the most appropriate environment for delivering the content? What materials will be used to facilitate learning? And importantly, do these materials effectively support the pedagogical objectives defined in the design phase?

Implementation. The implementation phase involves the actual delivery of the training. It is essential to address the following questions: Are the teaching methods being applied correctly? Are there any deviations that can be corrected during this phase? What new training-related issues arise, and how can they be managed effectively?

Evaluation. The final phase is evaluation. This step assesses the effectiveness of the training in relation to the defined learning objectives. To what extent were the learning

objectives achieved? How effective were the teaching methods in facilitating learning? Were there any technical issues? And are there any new training opportunities?

Through its iterative approach, ADDIE remains an essential tool in the field of pedagogical engineering [3, 4].

2.2 ADDIE Efficiency

The effectiveness of the ADDIE model in various educational contexts has been confirmed by several recent studies [5]. With the experimental group students outperforming the control group students in the post-test, the study [6] shows that each phase of the model positively contributes to the improvement of university students' learning outcomes.

Similarly, article [7] highlights how the ADDIE model enhances pedagogical practices while encouraging learner engagement, critical thinking development, and personalization of instruction. In the realm of language learning, authors of the paper [8] demonstrate that the incorporation of the model into a digital setting greatly enhances students' creative writing abilities in English as a Foreign Language (EFL), especially regarding originality, accuracy, and fluency. The usefulness of the ADDIE model for structuring online courses, like MOOCs, through interactive and multimedia strategies is finally confirmed by a recent meta-analysis in a study [9], though modifications are required to get around its rigidity.

These studies demonstrate how the ADDIE model can improve learning outcomes and change educational practices in a variety of settings.

2.3 Adaptability of the ADDIE Model

The ADDIE model has demonstrated its flexibility and ability to evolve to meet modern educational needs. Study [10] has shown how ADDIE can integrate specific technologies to enrich educational modules. For instance, the X-ADDIE model adds an experimental pilot phase to improve the quality of distance learning courses [11]. The study [12] was inspired by ADDIE to create the 6P4C model, combining learner-centered principles and innovative technological approaches. Finally, study [1] revealed, through a systematic review, that the integration of technologies in ADDIE enhances student learning and engagement. These adaptations illustrate the flexibility of ADDIE and pave the way for the exploration of emerging technologies, such as generative artificial intelligence, to further modernize this model.

2.4 Using Artificial Intelligence in the Instructional Design Process

Integrating AI into the instructional design process model offers considerable potential for improving the effectiveness of instructional design. The following Table 1 provides a summary of the specific contributions of AI to each phase of the ADDIE model.

Table 1. AI contributions in each phase of the ADDIE model

Phase	Study	Contribution of AI
Analysis	[13]	ChatGPT is used to analyze learning needs, identify gaps, and generate recommendations
	[1]	AI analyzes learning needs and creates personalized recommendations
Design	[9]	Use of generative AI to personalize learning paths based on identified needs
	[14]	AI is used for creating personalized content and engaging students through an educational chatbot
	[15]	Exploration of the impact of generative AI on the integration of educational tools and design practices
Development	[12]	The integration of AI in the development phase of education allows for the generation of educational content and interactive assessments
	[11]	Use of AI to improve course design and development, adding an experimental pilot phase
	[16]	Generative AI is used to enrich the visual and informational content of teaching materials
Implementation	[1]	AI is used to monitor student engagement and adjust educational tools in real-time
	[13]	The integration of ChatGPT to automate the creation of educational content and improve the efficiency of teaching tasks
	[15]	AI in assisting pedagogical integration
Evaluation	[7]	Use of AI to generate real-time feedback on student performance, facilitating quick and personalized assessment
	[2]	AI generates real-time assessments, providing personalized feedback on students' performance
	[17]	Use of AI to provide personalized assessments, create feedback, and adjust learning paths

While theoretical arguments highlight AI's potential to streamline processes and enhance instructional design [15], empirical studies provide evidence of its impact. Generative AI tools are employed by instructional designers to automate tasks and create learning materials [13], with applications ranging from personalized learning path design to automated content generation [17]. Research has shown that AI can effectively generate diverse learning content, with one study demonstrating comparable learning outcomes between AI-generated and traditional videos [18]. Furthermore, AI's capacity to adapt learning to individual needs and provide personalized feedback aligns with established principles of effective e-learning design [9].

Despite the demonstrated effectiveness of AI in enhancing instructional design, it is essential to explore also the challenges related to the use of AI, particularly the issues of ethics and bias, to ensure optimal and equitable application in education.

Our research therefore proposes an innovative approach combining the ADDIE model with the capabilities of generative AI tools to meet contemporary educational needs, while overcoming the identified limitations. In response to these challenges, and with the aim of improving the efficiency and ethics of instructional design, we propose an evolution of the ADDIE model: the ADGIE model. By integrating the strengths of AI automation and human intervention, this model aims to offer a more flexible, efficient and ethical approach to instructional design.

3 Methodology

An exploratory survey with important stakeholders in education to find out their needs, preferences, and perceptions regarding the use of generative AI technologies in instructional design served as the basis for this study. The ADGIE model, which integrates AI capabilities and human expertise, was conceptualized and proposed based on these findings. The steps of the process are described below:

3.1 Survey Sampling

90 professionals in the field of education represent the sample, including technical trainers (21%), teachers (36%), and instructional designers (43%). Participants were chosen based on two requirements: (1) having worked in the field of education or training for at least two years, and (2) having experience with digital learning and the use or design of educational solutions. Academic networks and tailored LinkedIn messages were used for recruitment. The purpose of the survey was to learn more about the requirements of educators regarding incorporating AI into their teaching methods. This included what tasks they would like to assign to AI, what assistance they require from AI, and how prepared they were for human-AI cooperation.

3.2 Data Analysis and Results

The survey data was analyzed using descriptive statistics to summarize participants' responses. Specifically, this involved calculating the percentage of respondents for each response option in each question. Table 2 presents the percentage distribution of respondents' readiness to integrate AI into the various pedagogical design tasks.

The analysis of the survey results highlights several key trends regarding the integration of generative AI into pedagogical practices:

A Strong Appreciation for Automation. Overall, respondents express a strong interest in the automation capabilities offered by generative AI. In particular, the suggestion of training materials (94%), the proposal of interactive exercises or activities (94%), and the suggestion of a course or training plan (83%) receive high approval ratings.

Table 2. Results of survey on participants' readiness to integrate AI into course design tasks

Question	Yes (%)	No (%)
Automatic content structuring	68	32
Suggestion for a course/training plan	83	17
Structuring pedagogical knowledge	86	14
Suggestion of training material	94	5
Proposal for exercises or interactive activities	94	5
Availability to validate the relevance of generated content	91	9
Participation in the selection of teaching methods	49 (very ready)	51 (other levels)

Interest in Knowledge Structuring. Automatic content structuring (68%) and pedagogical knowledge structuring (86%) are also viewed positively, indicating a need for assistance in organizing and managing pedagogical information.

Importance of Human Validation. Despite enthusiasm for automation, the majority of respondents (91%) said they were prepared to validate the relevance of AI-generated content, underlining the importance of human control and pedagogical expertise in the process.

Divergent Opinions on the Selection of Teaching Methods. Opinions are more divided when it comes to respondents' involvement in the selection of teaching methods, with 49% declaring themselves "very ready" and 51% expressing other levels of disposition. This suggests a certain caution about collaborating with the IA on fundamental pedagogical decisions for the IA.

In summary, the survey reveals a significant openness of education professionals towards generative AI, particularly for automation and structuring tasks. However, the need for human supervision and close collaboration between humans and AI is clearly stated, especially for aspects related to content validation and the choice of teaching methods.

4 Proposal for a New Model: ADGIE (Designer-AI)

The AI-Designer-Learner (ADGIE) model is an instructional design framework that emphasizes close collaboration between Artificial Intelligence (AI), the instructional designer, and, implicitly, the learner. This model systematically integrates AI at each phase. Tasks assigned to AI and humans are clearly indicated by keywords (e.g., 'AI' for automated actions, 'Designer' for human interventions), highlighting their synergistic collaboration. The 'Iterative Evaluation' column, present at each stage, underscores the central role of human validation to ensure the quality and ethics of the process (see Fig. 2).

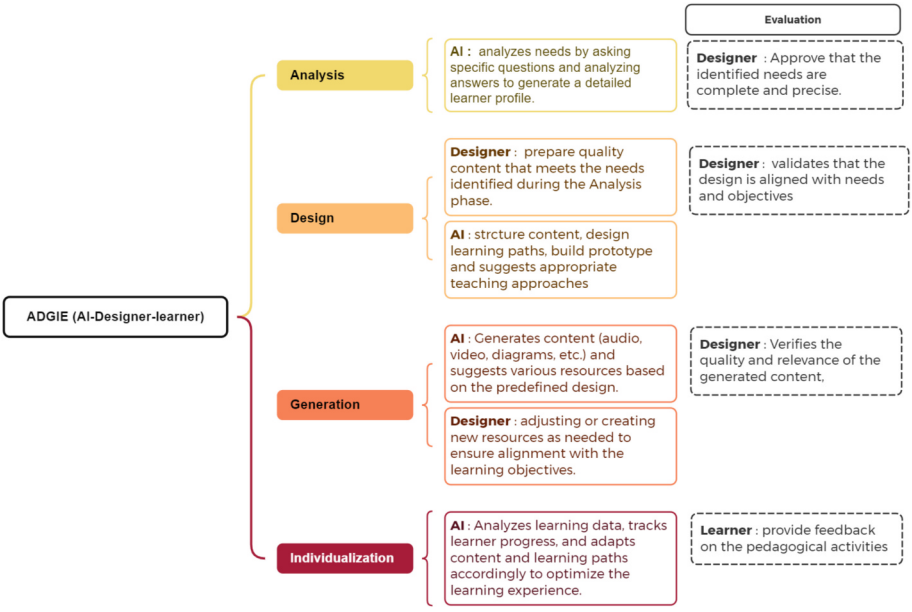

Fig. 2. ADGIE Model: AI-supported instructional design cycle

The ADGIE model is structured around five interdependent phases, each contributing to a coherent integration of AI into the instructional design process:

4.1 Analysis

The AI could leverage natural language processing techniques (NLP) and a decisions tree fed by questions on needs analysis on various pedagogical characteristics to ask diagnostic questions and interpret the answers to generate a detailed learner profile. The designer then validates the consistency of the personas with the identified training needs, hence establishing a solid basis for the design phase.

4.2 Design

The designer collects quality and relevant content that meets the needs identified during the analysis phase. The AI model trained in pedagogical decisions supports this process by structuring the content, generating training plans, pedagogical scenarios and prototypes, and suggesting suitable pedagogical approaches, depending on the nature of the content.

4.3 Generation

The designer selects a teaching scenario sequence, and the AI generates content, such as audios, videos, diagrams and other resources. Although the AI produces most of

the content, the designer must evaluate whether the generated content is insufficient or misaligned and adjust existing material or create new resources to ensure that the learning experience remains aligned with the learners' objectives and needs. The designer will keep his role as content creator but will be assisted by AI and save time on this task.

4.4 Individualization

AI analyzes learning data, tracks learner progress and adapts content and learning paths accordingly to optimize the learning experience. For example, if a learner has difficulty with a written explanation, AI can generate a video summary or an interactive simulation of the same concept. Or if a learner shows a strong interest in a particular sub-theme, AI can generate additional and in-depth materials, such as articles, case studies, or even interactive quizzes, to encourage further exploration. The learner could be involved by providing feedback on learning activities.

4.5 Evaluation (Iterative)

This step is transversal and is applied to all the other steps in the process. It is based on a cycle of continuous improvement, involving both validation of AI by the designer and feedback from learners.

The ADGIE model is designed to meet the specific AI integration needs and preferences of education professionals, as identified in the exploratory survey. It emphasizes a strong valuation of automation, particularly in content creation ('Generation' phase of the ADGIE model, where AI is tasked with generating various learning resources). The results also reveal a desire for AI support in the organization and structuring of educational content, which has influenced ADGIE's 'Design' phase, where AI is used to structure content and design learning paths. The results also underline the importance of human validation. This human supervision is particularly highlighted in the 'Evaluation' phase, which is iterative and involves continuous validation by the designer. These results have collectively shaped the design and functionality of the ADGIE model, ensuring that it is rooted in the practical needs and preferences of its target users.

5 Discussion

This research presents the ADGIE model, which integrates generative AI with the ADDIE model to improve the efficiency, personalization and adaptability of instructional design. Our results show that AI facilitates the automation and optimization of content, generating strong interest among educators for its use in suggesting resources, creating interactive exercises and generating lesson plans. What's more, ADGIE emphasizes the importance of human supervision to guarantee pedagogical relevance and take ethical issues into account. Its iterative approach, incorporating continuous evaluation, enables it to adapt to learners' needs and technological developments.

The validation of the ADDIE model as a basis for pedagogical engineering is supported by several studies that underline its effectiveness, particularly when integrating technologies. The work of H. Abuhassna *et al.* [1], A. Adeoye *et al.* [7] ,and A. Almelhi

[8] confirms the positive influence of ADDIE in this context, justifying its use as the foundation of ADGIE. In addition, the study Sial *et al.* [6] provides empirical evidence of its effectiveness in university teaching, reinforcing the argument for a structured framework. However, P. C. Campbell's [10] article highlights the need to adapt ADDIE to specific technological needs, particularly when integrating AI, and warns against the idea that technology is a silver bullet. He stresses the importance of a thorough analysis of stakeholders' technical knowledge and adequate technological infrastructure, so as not to lose sight of fundamental educational objectives.

The integration of generative AI in education is changing pedagogical design in significant ways, as highlighted by various recent studies. Chiu's [19]recommendations emphasize the need to rethink higher education with AI, revising learning outcomes and adopting interdisciplinary pedagogies, thus fostering an adaptable, AI-centric pedagogical approach. Meanwhile, the study by Moundridou, Matzakos and Doukakis [20] provides a concrete overview of the use of generative AI tools as assistants for educators, particularly in the design of lesson plans for inquiry-based learning (IBL), and focuses on the critical evaluation of generated content, in line with ADGIE's aim of improving efficiency and personalization. Finally, the study by Mostafa, Saleh and Abdelazia [16] validates the use of generative AI in instructional design based on the ADDIE model, confirming the potential of these tools to create engaging educational experiences, while emphasizing the importance of measuring results, taking into account the target audience and pedagogical objectives.

Beyond the integration of AI, it is imperative to highlight the fundamental aspects of pedagogical design that remain essential to the effectiveness of learning. Several recent studies highlight the crucial aspects of instructional design. The study by Ozdilek and Robeck [21] highlights the paramount importance of learning needs analysis, particularly learner characteristics, a stage where AI can provide real-time analysis. Furthermore, the work of Handrianto et al. [22] emphasizes planning, curriculum implementation, technology use, and classroom management, while validating the flexibility of ADDIE for adaptation and continuous evaluation. The practical application of generative AI in creating a chatbot for learning Japanese, studied by Rifai et al. [14], illustrates the potential of AI for personalized learning and the importance of analyzing learners' needs and continuous assessment. In addition, Byrne's 6P4C model [12] offers a rich conceptual framework, emphasizing community, collaboration, learner-centered design, continuous assessment, and consideration of the learning context, all essential principles for designing meaningful online learning experiences.

In this era of technological transformation, it is crucial not to lose sight of the central role of humans in education. The importance of the human element in pedagogical design, particularly in the era of AI, is highlighted by several recent studies. Spatioti, Kazanidis, and Pange [9] emphasize continuous assessment and human factors such as self-regulation, collaboration, and learner attitudes. Ch'ng [15] emphasizes the need for a balanced approach between human and technology, the importance of human-machine interaction, and the emergence of new human roles. Finally, Somin and Hoojo [23] emphasize the importance of training teachers and students in the use of AI, as well as the necessity of human supervision to avoid errors, highlighting a skills-based and experiential learning approach.

Unlike traditional models like ADDIE, ADGIE stands out for its increased efficiency thanks to AI automation, allowing for faster design and reducing the workload of educators. It offers superior personalization by adapting learning to individual needs through AI, and enhanced adaptability thanks to continuous assessment. Moreover, ADGIE ensures an ethical integration of AI through vigilant human supervision, while promoting the development of teachers' pedagogical skills by allowing them to focus on high-value tasks.

Despite its advantages, the ADGIE model faces significant challenges. Its effectiveness is heavily dependent on the quantity and quality of the available data. Moreover, adequate training of teachers is crucial for the successful integration of AI tools into pedagogical practices. Finally, ethical considerations are essential to avoid potential biases and ensure equitable access to AI-based education.

Future research on the ADGIE model should prioritize its empirical validation in real educational contexts to assess its effectiveness and identify necessary improvements. It is also crucial to explore its scalability and sustainability to ensure long-term implementation. Finally, the development of robust ethical frameworks is essential to guide the integration of AI in education in a responsible and equitable manner.

6 Conclusion and Perspectives

This article presents an innovative model, ADGIE (Designer-AI), which revisits the traditional ADDIE framework by integrating close collaboration between generative artificial intelligence (AI) and humans (Designer) at each phase of the instructional design process. This model meets the challenges posed by traditional approaches in terms of personalization, efficiency and flexibility of learning paths, while preserving pedagogical robustness thanks to human intervention.

Automating tasks such as needs analysis, content creation and evaluation in the ADGIE model improve operational efficiency by reducing design times and accelerating iteration, while allowing the designer to focus on more strategic tasks. By leveraging the capabilities of AI, this model offers increased personalization of content, tailored to the specific needs of learners, making the learning experience more engaging and relevant. Collaboration between AI and the designer enables the educational pathways to be refined, while human supervision guarantees the relevance of the content, limits algorithmic bias and ensures that it is implemented ethically and adapted to the context. Finally, the iterative phase enables continuous improvement, based on validation by the designer, feedback from learners and technological advances, ensuring constant adaptation to educational needs.

The proposed model, while a promising area of innovation, presents inherent challenges. The implementation and development of this model are major obstacles, requiring advanced technical and pedagogical solutions. In addition, there is potential resistance to change on the part of teachers and designers. Rigorous large-scale empirical validation remains essential to establish its effectiveness and adaptability to diverse educational contexts.

Our next work will focus on developing an authoring tool utilizing the ADGIE model. This instrument will be essential for conducting empirical validations of the

proposed model across diverse real-world educational settings, encompassing higher educational institutions education and vocational training in several disciplines. This empirical validation through testing is essential for establishing optimal implementation techniques and for rigorously comparing the efficiency of the ADGIE model with traditional frameworks such as ADDIE. Moreover, there are promising prospects to enhance content development processes and elevate student engagement through the incorporation of emerging technologies such as augmented reality, immersive platforms, and other innovations. The ADGIE paradigm facilitates the development of intelligent adaptive learning systems that optimize and personalize each student's educational trajectory in real time.

In summary, the ADGIE model sets the standard for more flexible and successful instruction by fusing AI and human knowledge. It drives tomorrow's adaptive learning by addressing today's educational challenges.

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