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THE EFFECTIVENESS OF DESIGNING E-LEARNING COURSES BASED ON THE ADDIE MODEL SUPPORTED BY ARTIFICIAL INTELLIGENCE TOOLS AMONG GRADUATE STUDENTS IN THE COLLEGE OF ARTS AND HUMANITIES, JAZAN UNIVERSITY

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ABSTRACT

This study aims to examine the effectiveness of designing e-learning courses based on the ADDIE instructional design model supported by artificial intelligence (AI) tools in enhancing learning quality and improving students' performance in higher education settings. The study stems from the growing need to integrate well-established instructional design models with emerging technologies, where the ADDIE model provides structure and systematic processes, while AI tools contribute to personalization, enhancement of content quality, and immediate adaptive feedback. AI tools were incorporated across all stages of the ADDIE model: the analysis phase utilized intelligent learning analytics to understand learner needs; the design and development phases employed automated content-generation systems and AI-based evaluation tools; and the implementation and evaluation phases relied on adaptive assessment platforms and performance dashboards to monitor learners' progress. The electronically designed course was applied to a sample of graduate students, and its impact was measured in terms of cognitive achievement, digital skills, and students' attitudes toward AI-supported learning environments. The results revealed significant improvements in the performance of students who studied using the AI-enhanced ADDIE-based course compared to those in traditional learning environments. Findings also indicated high levels of student satisfaction attributed to personalized content, continuous interaction, and instant feedback that supported autonomous learning. The study concludes by emphasizing the importance of integrating AI technologies within instructional design models and recommends incorporating AI competencies into teacher-preparation programs. It also encourages higher education institutions to adopt intelligent design practices that enhance learning outcomes and keep pace with digital transformation trends.

KEYWORDS: ADDIE Instructional Design Model, Artificial Intelligence in Education, E-learning Course Design, Student Learning Outcomes

1 INTRODUCTION

Over the past decade, higher education has undergone profound transformations resulting from the accelerated advancement of digital technologies, particularly in the field of e-learning. Recent literature confirms that the shift toward digital learning is no longer optional; rather, it has become an urgent necessity to enhance educational quality and meet the demands of flexible and personalized learning. Studies have shown that e-learning courses contribute to strengthening interaction, expanding access to content, and providing learning experiences that transcend the traditional constraints of time and place—especially at advanced stages of university education.

In this context, the **ADDIE model** has emerged as one of the most widely used instructional design models for developing e-learning courses due to its ability to offer a well-structured methodological framework encompassing analysis, design, development, implementation, and evaluation. A 2024 study by *Abuhassna et al.* indicated that the ADDIE model possesses a high degree of flexibility that allows the integration of modern technologies, and that embedding technology within the model enhances learning quality and enables the construction of highly efficient courses across diverse educational settings.

With the increasing prevalence of artificial intelligence (AI) in education, recent reviews have demonstrated that AI tools—such as intelligent analytics, adaptive assessment systems, automated content generation, and instant feedback—have contributed to transforming learning environments into more interactive and personalized ones. A 2023 study by *Gligorea et al.* showed that AI enhances adaptability in e-learning environments, improves achievement, increases motivation, and addresses limitations in traditional e-learning strategies.

Furthermore, a 2024 study by *Halkiopoulos & Gkintoni* highlighted that integrating AI into e-learning supports personalized learning by offering educational pathways aligned with each learner's capabilities and needs, in addition to improving assessments and providing accurate, immediate feedback.

Studies focusing specifically on integrating AI within the ADDIE model have confirmed that such integration transforms the model from a traditional design framework into a dynamic and intelligent system capable of enhancing all stages of instructional design. *Qian & Hassan (2026)* noted that AI is no longer merely a supportive tool for designers but has become a “**partner**” that contributes to decision-making, data analysis, and intelligent

content generation that enhances learning quality.

The significance of this study is particularly pronounced in the context of graduate programs in colleges of arts and humanities, where learners require digital learning environments characterized by depth, support for critical thinking, development of research skills, and expanded opportunities for interacting with digital content. However, the literature indicates a clear gap in applying AI-supported instructional design models in this specific context, despite the pressing need for them.

Therefore, this study aims to measure the effectiveness of designing an e-learning course based on the ADDIE model—when supported by AI tools—in improving cognitive achievement, digital skills, and attitudes toward e-learning among graduate students. This study responds to recent research calls emphasizing the need for actual evaluation of the impact of integrating AI into instructional design, rather than merely describing its theoretical potential.

Thus, the present study represents a scientific effort to fill an important research gap and contribute to enriching educational knowledge concerning the best methods for developing advanced e-learning courses that align with the demands of higher education in the digital age. (Hariri, 2021, p. 367)

Given the Kingdom of Saudi Arabia's recognition of its leading civilizational role at Arab, Islamic, and global levels, its Vision 2030 emphasized—within the “Thriving Economy” pillar—the importance of investing in AI technologies to drive digital transformation across all domains, including their use in designing e-learning courses. This contributes to technological progress that supports economic development (Saudi Vision 2030, 1437H). The National Center for E-Learning also launched the “**AI Framework in Digital Education 2023**”, reinforcing the strategic direction toward integrating AI in education.

2 RESEARCH PROBLEM

In recent years, there has been a noticeable increase in the use of artificial intelligence (AI) technologies in the design of e-learning courses. Numerous studies have highlighted the role of AI in enhancing learning and improving the quality of instructional design processes. For example, the comprehensive study conducted by *Abuhassna et al. (2024)* found that integrating modern technologies within the ADDIE model significantly contributes to improving learning quality and providing interactive learning environments. The study also confirmed that the ADDIE model possesses high flexibility when

integrated with modern technologies, which positively affects learning quality and student performance.

A study by *Gligorea et al. (2023)* indicated that AI is a fundamental factor in enhancing adaptation and personalization in e-learning environments. Through an analysis of 63 studies, their findings showed that AI tools contribute to improving achievement, motivation, and engagement.

Additionally, *Mahafidh et al. (2024)* demonstrated that integrating AI into e-learning enhances the ability to predict students' performance levels and improves learning outcomes through intelligent assessment techniques.

Moreover, *Qian & Hassan (2026)* concluded that AI is no longer merely an assisting tool, but has evolved into a "design partner" capable of fundamentally influencing the instructional design process. This calls for the development of traditional design models to keep pace with this transformation.

Despite this growing body of evidence, several studies—such as *Spatioti et al. (2023)*—indicate that many e-learning courses in higher education institutions still do not fully utilize the potential of integrating instructional design models with AI technologies, which limits their effectiveness.

Accordingly, the problem of the present study lies in the existence of both a knowledge gap and an application gap concerning the effectiveness of designing e-learning courses based on the ADDIE model supported by AI tools, particularly among graduate students in colleges of arts and humanities. Most prior studies have focused on general or technical education, while studies targeting advanced humanities programs remain scarce.

Therefore, the central research problem can be expressed in the following main question:

What is the effectiveness of designing e-learning courses based on the ADDIE model supported by artificial intelligence tools in developing cognitive achievement, digital skills, and attitudes toward e-learning among graduate students in the College of Arts and Humanities?

Sub-questions

1. What is the effect of the e-learning course designed according to the ADDIE model supported by AI on cognitive achievement among graduate students?
2. What is the effect of the same model on developing digital skills?
3. What is the effect of the e-learning course on graduate students' attitudes toward AI-supported e-learning?

4. What is the level of student satisfaction with the e-learning course designed based on the ADDIE model supported by AI tools?

Research Objectives

1. To verify the effectiveness of designing an e-learning course based on the ADDIE model supported by AI in improving cognitive achievement among graduate students.
2. To measure the impact of using this model in developing digital skills.
3. To identify students' attitudes toward AI-supported e-learning.
4. To determine the level of student satisfaction with the learning experience within the e-learning course.

Research Hypotheses

There are statistically significant differences between the mean scores of the experimental and control groups in the post-achievement test in favor of the experimental group.

1. There are statistically significant differences between the mean scores of the two groups in digital skills in favor of the experimental group.
2. There are statistically significant differences in attitudes toward e-learning in favor of the experimental group.
3. Graduate students show a high level of satisfaction with the e-learning course designed according to the ADDIE model supported by artificial intelligence.

Research Significance

First: Theoretical Significance

- Contributes to enriching the literature related to integrating artificial intelligence into instructional design models.
- Clarifies mechanisms for applying the ADDIE model in a contemporary manner aligned with intelligent technologies.
- Provides a modern framework that can be relied upon in designing e-learning courses for graduate studies.

Second: Practical Significance

- Provides course designers with practical mechanisms for developing more effective e-learning courses.
- Supports colleges of arts and humanities in improving the quality of their educational outcomes.
- Helps enhance students' digital skills and increase their satisfaction with e-learning environments.

Research Delimitations

- **Human Delimitations:** A systematic random sample of graduate students in the College of Arts and Humanities.
- **Subject Delimitations:** Measuring the effectiveness of an e-learning course designed based on the ADDIE model supported by AI.
- **Temporal Delimitations:** The field study was conducted in the first semester of the academic year 1447 AH.
- **Spatial Delimitations:** The research tool was applied in the College of Arts and Humanities, Jazan University.

Research Terms

ADDIE Model

An instructional design model consisting of five stages: Analysis, Design, Development, Implementation, and Evaluation. It is used as the basis for building the e-learning course (Abuhassna et al., 2024).

Artificial Intelligence (AI)

Defined as “the ability of a system to correctly interpret external data, learn from such data, and use that knowledge to achieve specific goals and tasks through flexible adaptation” (Kaplan & Haenlein, 2019, p.17).

AI Tools

Include content-generation tools, intelligent analytics, adaptive assessment systems, and instant feedback tools, which will be used to support the stages of the ADDIE model.

E-learning Courses

Courses delivered through a learning management system, containing digital content and interactive activities (Mawadah et al., 2024).

Learning Effectiveness

Measured through cognitive achievement, digital skills, and attitudes toward e-learning after implementing the intelligent, data-driven, and deep-learning-based experience.

3 THEORETICAL FRAMEWORK AND PREVIOUS STUDIES

1. The ADDIE Model in Instructional Design

The ADDIE model is considered one of the most widely used models in the field of instructional design, owing to its systematic nature, which is based on five interconnected stages: **Analysis, Design, Development, Implementation, and Evaluation.**

The model is characterized by its flexibility and high adaptability to the integration of modern educational tools and technologies.

The comprehensive systematic study conducted by *Abuhassna et al. (2024)* confirmed that the ADDIE model remains a balanced and highly suitable framework for contemporary digital education, and that its integration with modern technologies—especially AI—significantly enhances learning quality and the effectiveness of e-learning course design.

Similarly, *Spatioti et al. (2023)* indicated that the ADDIE model is central to improving learning efficiency, developing organizational skills, and strengthening students’ self-directed learning, emphasizing its high compatibility with e-learning environments.

2. Artificial Intelligence in E-Learning

Artificial intelligence has become one of the essential pillars of modern e-learning development, contributing to the transformation of traditional learning environments into highly interactive and adaptive ecosystems.

A study by *Gligorea et al. (2023)* demonstrated that AI can personalize learning pathways, analyze student behaviors, and provide instant feedback, which leads to improved academic performance and greater learning motivation.

Additionally, *Halkiopoulou & Gkintoni (2024)* found that integrating AI into e-learning increases learner engagement, enhances interaction and adaptability within educational activities, and improves the quality of smart assessments.

Likewise, *Mahafdah et al. (2024)* showed that employing AI in academic performance prediction systems enhances educational quality by identifying early indicators of students’ improvement or decline.

3. Integrating Artificial Intelligence within the ADDIE Model

Recent studies have indicated that the ADDIE model can be transformed into a more intelligent and dynamic model through the integration of AI tools across its various stages.

The report by *Qian & Hassan (2026)* emphasized that AI is no longer merely a supportive tool in instructional design; rather, it has become a “**cognitive partner**” capable of predicting needs, generating intelligent content, and analyzing interaction in real time.

A study by *Haitham Nagieb (2024)* also revealed that AI tools—such as automatic content generation and data analytics—significantly improve the design

and development stages, saving instructional designers considerable time and effort.

Additionally, Luo *et al.* (2025) supported the concept of integration, confirming that AI-based educational tools enhance learners' digital competencies and provide more personalized and effective learning environments.

4. E-Learning Courses and Their Effectiveness in Higher Education

E-learning courses have become a fundamental component of modern educational environments, with numerous studies demonstrating their contribution to improving learning—particularly when designed based on rigorous instructional design principles.

The study by Spatioti *et al.* (2023) showed that the effectiveness of any e-learning course depends on the quality of its design, the nature of embedded interaction, and the extent to which it meets learners' needs.

Similarly, Mahafidah *et al.* (2024) found that e-learning courses integrated with AI provide higher levels of personalization and performance prediction, leading to improved academic outcomes and increased learner engagement.

5. Graduate Students and Their Educational Needs

Graduate programs require flexible and interactive learning environments that rely on personalization, facilitate access to scholarly sources, and strengthen research and analytical skills.

The literature indicates that graduate students need educational settings that support autonomous learning and provide advanced feedback—characteristics that align strongly with AI capabilities in e-learning courses.

4 METHODOLOGICAL PROCEDURES RESEARCH METHOD

The study relies on the quasi-experimental method using the design of an experimental group and a control group, in order to measure the effect of the e-learning course on the dependent variables.

Research Population and Sample

The research population consists of all graduate students in the College of Arts and Humanities at Jazan University in the Kingdom of Saudi Arabia, totaling 611 students.

To determine the appropriate sample size, Steven Thompson's (2012) formula was used:

Where:

$$n = \frac{N \times p(1-p)}{[N - 1 \times (d^2 \div z^2)] + p(1-p)}$$

- N = population size
- Z = standard score for significance level (0.05) with a confidence level of 95% = 1.96
- d = margin of error = 0.05
- P = probability value = 0.50

According to the applied formula, the suitable sample size was 297. The number was rounded to 298 to ensure compensation for any lost responses in electronically distributed questionnaires.

Participants were selected using **systematic random sampling**, calculated by dividing (population÷sample): $611 \div 297 = 2.1$.

Thus, the first listed student was selected, followed by student number 3, then 5, and so forth until reaching (298) participants. The research tool was administered electronically through Google Forms.

Table (1): Distribution of the Research Sample According to Academic Level and Specialization Distribution of the Sample by Academic Level and Specialization

Characteristics	N	%	Total Sample
Academic Level			
Second	99	33%	
Fourth	199	67%	
Total	298		100%
Specialization			
Educational Sciences	4	0.7%	
Behavioral Sciences	112	38.2%	
Languages	182	61.1%	
Total	298		100%

Research Instruments

The study used the following instruments:

- An **achievement test** to measure cognitive knowledge
- A **digital skills scale** to measure performance-based skills
- A **scale of attitudes toward e-learning**
- A **student satisfaction questionnaire** about the e-learning course

Performance Analysis Scale via the Blackboard Platform

Instrument Validity and Reliability Internal Consistency

1. Correlation Coefficients

- Correlation between each item and the total score
- Correlation between each domain and the total score

- All correlations were significant at (0.05) or (0.01), indicating strong internal consistency.

2. Cronbach’s Alpha Internal Consistency

- 0.70–0.80 = acceptable
- 0.80–0.90 = good
- 0.90+ = excellent

Cronbach’s Alpha was calculated for all four instruments:

- Achievement test
- Digital skills scale
- Attitude scale
- Satisfaction questionnaire

External Reliability

1. Test–Retest Method

- Instruments were applied to a pilot sample
- Reapplied after two weeks
- A reliability coefficient ≥ 0.70 indicates good stability

2. Split-Half Reliability

- Items divided into odd/even halves
- Correlation computed
- Then adjusted using Spearman–Brown formula

Content Validity (Expert Review)

A panel of specialists in instructional technology and curriculum evaluated:

- Appropriateness of items for objectives
 - Clarity of wording
 - Coverage of dimensions
 - Scientific accuracy and linguistic quality
- Revisions were made accordingly.

Construct Validity

- Correlation across domains
- Item-domain alignment
- Verification that the scale structure reflects the intended construct

Specification Table for the Achievement Test (20 MCQs)

Relative Weight	Recall	Understanding	Application/ Analysis	Total Items	Dimension
30%	2	2	2	6	ADDIE
25%	1	2	2	5	AI in Design/Development/Evaluation
25%	1	2	2	5	E-Learning Course Design
20%	1	1	2	4	Analytics and Adaptive Assessment
100%	5	7	8	20	Total

Digital Skills Scale Specification (30 items)

Response Scale	Description	No. of Items	Sample Indicators	Domain
5-point Likert	Content & assignment management	6	Uploading resources, tracking progress	LMS Use
5-point Likert	Interactive media authoring	6	Storyline / Genially / Canva	Digital Authoring
5-point Likert	Reading LMS dashboards	6	Completion rates, time logs	Analytics & Data
5-point Likert	AI content & responsible use	6	Prompting, documentation	AI & Privacy
5-point Likert	Group work & cloud collaboration	6	Comments, cloud editors	Academic Collaboration

Attitude Scale Toward AI-Supported E-Learning (20 items)

Response Type	Description	Items	Sample Items	Domain
Likert	Enhances quality & efficiency	8	Supports personalization	Perceived Benefit
Likert	Ease of learning & using tools	6	Interface clarity	Ease of Use
Likert	Privacy/bias concerns	6	Reverse items like “reduces autonomy”	Ethical Concerns

Satisfaction Questionnaire (12 items)

Response Type	Description	Items	Sample Items	Domain
Likert	Modernity, accuracy, rich media	3	Content appropriate for graduate level	Content Quality
Likert	Interaction & feedback	3	Received immediate feedback	Interaction
Likert	Adaptive pathways	3	Course path suited my needs	Personalization
Likert	Navigation & accessibility	3	Multi-device access	Accessibility

5 DISCUSSION OF RESULTS

This study aims to identify the effectiveness of designing an e-learning course based on the ADDIE model supported by artificial intelligence (AI) tools for graduate students in the College of Arts and Humanities, through measuring its impact on:

- Cognitive achievement
- Digital skills

- Attitudes toward AI-supported e-learning
 - Student satisfaction with the learning experience
- The discussion of results is presented as follows:

First: Discussion of the Cognitive Achievement Result

The results showed statistically significant differences between the post-test means of the

experimental and control groups in favor of the experimental group. This indicates that the e-learning course designed according to the ADDIE model and supported by AI tools was more effective in improving cognitive achievement among graduate students.

Interpretation of the results:

- Designing the course according to ADDIE enabled the organization of content in a clear, sequential structure—from needs analysis to evaluation—thus enhancing learning quality.
- Integrating AI tools (such as adaptive recommendations, generated examples, and instant feedback) helped address individual differences and improve understanding.
- Adaptive assessment tools provided learners with questions aligned with their proficiency levels, which strengthened their comprehension.

Consistency with previous studies:

These findings agree with *Gligorea et al. (2023)*, who confirmed that AI enhances learners' cognitive performance through personalization and data-driven analysis. They also align with *Abuhassna et al. (2024)*, who showed that integrating technology within the ADDIE model significantly improves learning quality.

Second: Discussion of the Digital Skills Result

The results showed a significant improvement in digital skills among the experimental group compared to the control group, indicating that learning within an AI-supported course enhances the acquisition of technological skills required in graduate-level learning environments.

Interpretation:

- The course included AI-based interactive digital activities, which required students to use LMS tools and multimedia resources extensively.
- The course tasks employed digital authoring and AI-supported content creation (e.g., text generation, data analysis, LMS report interpretation).
- Continuous use of the LMS and related digital tools enabled students to naturally acquire advanced digital skills.

Consistency with previous studies:

This aligns with *Luo et al. (2025)*, which demonstrated that AI-based educational tools enhance learners' digital competencies. It also supports *Mahafđah et al. (2024)*, which showed that AI

contributes to developing technical skills through data-driven learning activities.

Third: Discussion of Attitudes Toward AI-Supported E-Learning

The results showed positive attitudes among students in the experimental group toward AI-supported e-learning, compared to the control group.

Interpretation:

- Students perceived AI as a tool that personalized their learning experience.
- AI reduced cognitive and technical load through smart recommendations and instant feedback.
- Confidence in the digital learning environment increased due to clear, AI-generated pathways and instructions.

Consistency with previous studies:

This result is consistent with *Halkiopoulos & Gkintoni (2024)*, who confirmed that AI enhances positive attitudes toward e-learning due to increased interactivity and flexibility. It also aligns with recent literature showing that AI boosts motivation and learner satisfaction.

Fourth: Discussion of Student Satisfaction Result

The findings showed high levels of satisfaction among students with the course designed according to the AI-enhanced ADDIE model.

Interpretation:

- The intelligent learning environment provided learners with a sense of personalization, as though the course was tailored to their individual needs.
- AI tools enhanced content clarity and platform usability.
- Adaptive pathways improved the learning experience compared to traditional course designs.

Consistency with prior literature:

This finding supports *Spatioti et al. (2023)*, which emphasized that course design quality and interactive content are the strongest contributors to student satisfaction in e-learning environments.

Fifth: General Summary of the Discussion

The results of the study clearly indicate that integrating artificial intelligence within the ADDIE model is not merely a technological enhancement, but a qualitative transformation in instructional design. This integration contributed to:

- Improving cognitive achievement
- Enhancing digital skills
- Strengthening positive attitudes toward smart learning
- Increasing student satisfaction with the learning experience

The most influential factors appear to be the AI capabilities of personalization, interaction, prediction, and instant feedback-capabilities that were not available in the traditional ADDIE model before the integration of AI technologies.

Recommendations

1. Adopting the AI-enhanced ADDIE model in designing e-learning courses in graduate programs.
2. Establishing technological support units within colleges to train faculty members on AI-based educational tools.
3. Designing instructional activities that rely on AI-supported personalization.
4. Employing AI-based content-generation tools to improve the quality of digital tasks and projects.
5. Encouraging students to develop their digital skills through continuous engagement in smart learning environments.
6. Guiding students to use AI tools responsibly and ethically.
7. Activating adaptive assessment within the course based on students' performance.
8. Integrating activities that simulate real-life tasks using AI tools. Suggestions for Future Research
 1. Investigating the effectiveness of using intelligent chatbots in supporting graduate students.
 2. Evaluating the impact of AI-generated content on preparing research projects.
 3. Studying the effect of AI-supported adaptive learning on the development of critical-thinking skills.
 4. Measuring the effectiveness of intelligent formative assessment on students' performance improvement over time.
 5. Developing an instructional design model based on *Generative Learning* using generative artificial intelligence.

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