An E-Learning Environment to Enhance Academic Engagement among Instructional Technology Students Using Artificial Intelligence Applications

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Abstract:

The study aimed to enhance academic engagement using artificial intelligence applications among instructional technology students by designing an interactive e-learning environment that fosters focus and active participation during the learning process.The targeted dimensions of academic engagement included focus, cognitive involvement, and learning motivation. The study employed a descriptive-analytical approach to examine relevant theoretical concepts, alongside an experimental approach to measure the impact of the e-learning environment. The experimental design and measurement tools were applied to a single group consisting of 80 first-year students from the Instructional Technology Department, Faculty of Specific Education, Minia University, who were purposively selected.The experimental treatment involved an AI-based e-learning environment implemented through the Moodle platform. Measurement tools included an achievement test to assess cognitive aspects and an academic engagement scale. Data were statistically analyzed using "SPSS.V 21," and the findings demonstrated the effectiveness of the e-learning environment in enhancing academic engagement.The study recommended the development of e-learning strategies to foster positive interaction and improve learning outcomes across various courses.

Keywords:

E-learning environment, academic engagement,
Artificial intelligence applications.

Introduction:

The current era is witnessing an increasing global competition among nations and societies to harness rapid technological revolutions. Technology and its applications are perceived as a decisive factor in achieving progress and leadership across various fields. Among the most significant of these modern technologies, Artificial Intelligence (AI) stands out as a pivotal tool that has brought about fundamental transformations in multiple sectors, including medicine, engineering, defense, manufacturing, investment, space sciences, communications, and education. This rapid evolution presents significant challenges for ministries of education, necessitating a review of their policies, curricula, and educational strategies to ensure adaptation to the demands of the modern industrial revolution.

In this context, educational researchers have shown increasing interest in exploring mechanisms to enhance AI awareness and integrate it into various stages of education, both theoretically and practically. According to *Mu (2019),* recent research suggests that incorporating advanced applications, such as AI, into the educational process contributes to improving educational systems and enhances their ability to keep pace with technological advancements. AI's role extends beyond merely improving traditional education; it also serves as a virtual assistant to teachers, providing immediate feedback and addressing deficiencies in conventional teaching methods.

Furthermore, *Fernandez (2019)* emphasizes that the transformations in the information society necessitate fundamental shifts in traditional educational systems. AI-based learning models offer new potentials for improving education quality at all levels by providing precise diagnostics of learning processes and delivering personalized content tailored to each learner's needs. This facilitates the seamless integration of Information and Communication Technology (ICT) into educational processes, thereby enhancing their effectiveness.

Higher education faces a significant challenge in the third millennium: the need to develop digital skills and enhance learners' abilities to navigate the modern technological environment. This includes planning for the use of digital technologies, designing curricula aligned with technological transformations, and providing flexible learning environments that support interaction between students and teachers across various digital platforms. In this regard, the New Zealand Universities Academic Audit Unit (*NZUAAU, 2006*) has emphasized the need to adopt new standards for measuring

education quality—ones that extend beyond student satisfaction to focus on "academic engagement" as a more precise indicator of students' interaction with the educational process.

Academic engagement is defined as the level of active interaction students exhibit with educational tasks and activities, reinforcing their sense of responsibility for their learning. A study by *Shaker Al-Mahamid and Ahmed Aribat (2005)* indicates that students with high levels of academic engagement achieve better academic results and are more committed to completing their university education compared to their less engaged peers. Additionally, active participation in university settings helps students develop emotional and social skills, such as emotion regulation, responsibility, goal-setting, and teamwork.

Academic engagement is influenced by several factors, including the learning environment, student-teacher relationships, teaching methods, and curriculum structure. In this regard, *Billig (2002)* explains that providing stimulating and supportive learning environments positively impacts academic engagement levels. These environments must accommodate students' individual differences, offer meaningful educational activities, and promote the learner's role as an active participant in the learning process.

One of the modern models that has proven effective in enhancing academic engagement is e-learning. A study by *Alexandra & Maria (2015)* found that e-learning environments offer students extensive opportunities to engage in educational tasks designed to align with their abilities and needs, thereby enabling them to achieve their learning objectives more efficiently. Additionally, research by *Karim Arfi (2021)* confirms that e-learning grants students a higher degree of control over their learning process by providing immediate feedback that enhances their motivation and encourages continuous interaction with academic content.

E-learning environments are distinguished by their ability to minimize distractions by delivering personalized content that aligns with learners' needs, thereby improving academic achievement and reinforcing a sense of accomplishment. These environments also support the development of critical thinking and collaboration skills, fostering deep engagement with academic tasks—making them an effective solution to contemporary educational challenges.

Based on these insights, and in light of the accelerating technological transformations, this study aims to propose a comprehensive e-learning

environment based on AI applications. The objective is to enhance academic engagement among educational technology students, providing a flexible and advanced learning experience that promotes positive interaction and improves the quality of educational outcomes.

Research Problem:

The research problem emerged from the following points:

- The Egyptian state's interest in developing education and promoting artificial intelligence (AI) technologies.
- The expansion of AI research in the field of education and its continuous development over time.
- An exploratory study revealed low levels of academic engagement among Educational Technology students.

Based on these observations, the current research problem was identified as the low academic engagement of Educational Technology students when using AI applications. This highlights the urgent need to design an e-learning environment that focuses on learner interaction, immersion, and active participation in the educational process.

Accordingly, the research problem can be addressed through the **following main research question: What is the effect of an e-learning environment on enhancing academic engagement using AI applications among Educational Technology students?**

Research Objectives:

The current research aims to enhance academic engagement using AI applications among Educational Technology students by investigating:

1. The effectiveness of an e-learning environment that integrates AI applications.
2. The impact of the e-learning environment on enhancing academic engagement using AI applications.

Research Significance

The significance of this research lies in the following points:

- Aligning with the national strategies of Egypt’s Vision 2030, which emphasize the adoption of technological innovations—particularly artificial intelligence (AI)—to support the educational process and enhance its outcomes.
- Contributing to global trends in integrating AI applications into education by clarifying emerging concepts, defining key terms, and highlighting the direct impact of this technology on improving learning

environments and fostering academic engagement.

- Identifying the unique contribution of this research to the field of educational technology by providing a theoretical and applied framework that demonstrates AI's role in enhancing learning quality and increasing learner interaction.
- Utilizing research findings to design academic programs based on academic engagement strategies, with a particular focus on developing skills for enhancing academic engagement through AI applications.
- Developing innovative educational programs aimed at fostering academic engagement among target learners, particularly university students, by leveraging advanced AI technologies to create adaptive and stimulating learning environments.

Research Delimitations

The current research is confined to the following delimitations:

1. **Human Delimitations**: The research experiment is applied to a group of first-year students from the Department of Educational Technology, Faculty of Specific Education, Minia University.
2. **Content Delimitations**: The research focuses on the dimensions of academic engagement using artificial intelligence (AI) applications.
3. **Temporal Delimitations**: The research experiment is conducted during the first semester of the 2024/2025 academic year.
4. **Spatial Delimitations**:
    - Computer labs in the Department of Educational Technology, Faculty of Specific Education, Minia University — to guide the research group's learning process and apply the research tools both pre-test and post-test.
    - Any suitable location with internet access for students to use the experimental treatment materials online. For those without internet access or personal computers, the faculty's computer labs will be available.

Research Terminology

- **E-Learning Environment**: *Operationally defined* as an electronic environment designed for delivering and creating educational content within a specific timeframe, aimed at enhancing performance according to pre-determined standards. It is characterized by flexibility, catering to individual differences among students, making the learning process more adaptable and effective. This environment provides electronically

driven solutions tailored to the learners' individual needs, characteristics, and learning styles, ensuring personalized learning experiences *(Al-Samarraie & Saeed, 2018).*

- **Academic Engagement**: *Operationally defined* as the degree a learner attains on the *Academic Engagement Scale*, reflecting their involvement in the learning process, encompassing both cognitive and emotional aspects. Learners achieve better outcomes when they are deeply engaged in their learning, with the level of learning increasing in direct proportion to their academic engagement *(Sinatra, Heddy, & Lombardi, 2015).*
- **Artificial Intelligence (AI) Applications**: *Operationally defined* as technological systems and tools used by learners to acquire modern technological skills, facilitating more effective learning and keeping pace with technological advancements. Examples include: *Presentations AI* and *Poised (Zawacki-Richter et al., 2019)*.

Theoretical Framework

First: E-Learning Environment

The study **by *Hind Al-Ghamdi* (2022)** highlighted that an e-learning environment is a comprehensive educational system that relies on utilizing information and communication technologies (ICT) to design and deliver educational and electronic activities. This environment allows learners to access educational content and interact with instructors and peers through various electronic platforms. It is characterized by flexibility in time and place, supporting self-directed learning, and offering opportunities to adapt to learners' individual needs. Moreover, it enhances both synchronous and asynchronous interactions through multiple tools, such as virtual classrooms, discussion forums, and online assessments.

Characteristics of the E-Learning Environment

Several studies have discussed the characteristics of e-learning environments, including those by ***Sara Al-Otaibi* (2022), *Ahmed Al-Zahrani* (2021), and *Mohamed El-Sayed* (2020)**. The key characteristics are as follows:

1. Flexibility: Enables learners to access educational content anytime and anywhere, allowing them to learn according to their own schedules and circumstances.
2. Electronic Interaction: Provides various tools for interaction between instructors and learners, such as virtual classrooms, discussion forums,

and live chats.

3. Personalization: Allows content customization based on learners' needs, supporting individual differences and enhancing the effectiveness of the learning process.
4. Multimedia Integration: Combines text, images, videos, and audio recordings, making learning more engaging and comprehensible.
5. Continuous Assessment: Offers systems for immediate online testing and direct feedback, helping to effectively measure educational progress.
6. Collaborative Learning: Promotes teamwork and cooperation among learners through online activities such as joint projects and electronic forums.

The Importance of Using E-Learning Environments

The study conducted by ***Fahad Al-Qahtani*** **and** ***Reem Al-Harbi*** **(2023)** aimed to highlight the significance of using e-learning environments for university students. The key points can be summarized as follows:

1. Expanding Access to Knowledge: E-learning environments allow learners to access educational content anytime and from anywhere, breaking down geographical and time barriers.
2. Enhancing Active Interaction: They provide communication tools such as virtual classrooms and online forums, fostering a collaborative educational environment between instructors and learners.
3. Developing Self-Learning Skills: These environments empower learners to independently search and explore information, strengthening their ability for self-directed learning.
4. Adapting to Individual Differences: E-learning environments offer content customization tailored to each learner’s needs, promoting a more effective educational process.
5. Continuous Assessment and Feedback: They provide instant online tests and feedback mechanisms, helping track learners' progress and identify their strengths and weaknesses.
6. Integrating Artificial Intelligence: AI technologies are used to analyze learners’ data and offer personalized content and activity recommendations suited to their academic level.
7. Electronic Presentations: E-learning environments support the use of digital presentations, such as simulations and augmented reality, which enhance learners’ engagement and deepen their understanding of

complex concepts.

Secondly: Academic Engagement

The study by ***Lam and Shernoff*** **(2017)** defines academic engagement as a mental state of satisfaction and positivity associated with academic pursuits, characterized by absorption, enthusiasm, and dedication. It is considered a positive experience that predicts enjoyment in learning. Academic engagement is reflected in an individual's interest in planning study activities, monitoring areas of academic underperformance, and attempting to address them. It involves a sense of immersion, where students are cognitively absorbed in their work, investing their efforts in understanding or mastering the skills and knowledge that academic tasks aim to reinforce.

Dimensions of Academic Engagement

The study by ***Maha Wali*** **(2022)** identified five dimensions of academic engagement, as revealed by the results of the psychometric properties test and factor analysis of the Academic Engagement Scale. These dimensions are as follows:

1. Commitment:
   This refers to the student's perseverance in overcoming academic challenges, viewing the academic year as a decisive battle in their life that they must win. It involves prioritizing the completion of required academic tasks and dedicating oneself to achieving academic goals.
2. Cognitive Processing:
   This dimension involves the student's ability to connect prior knowledge with new information in their academic field, engaging in deep processing of academic content, and organizing information into coherent cognitive structures.
3. Flow:
   Flow refers to the student's sense of enjoyment in academic tasks, characterized by losing track of time and being deeply immersed in studying without experiencing fatigue or boredom.
4. Positivity:
   This dimension reflects the student's active participation in group assignments, volunteering to help peers solve academic problems, and suggesting ways to create a more engaging and supportive learning environment.
5. Self-Development:
   The final dimension pertains to the student's efforts to improve

themselves independently by addressing areas of academic weakness, staying focused, and eliminating distracting thoughts that hinder their academic engagement.

Elements of Academic Engagement

The studies by ***Tiwari*** **(2012) and** ***Ramsey*** **(1995)** identified four core elements of academic engagement:

- Prioritizing work as a central life interest: Academic tasks become the main focus of a student's life, reflecting a deep sense of commitment.
- Active participation in work: Engaging fully in academic activities and contributing meaningfully to assigned tasks.
- Performance as a means of self-actualization: Viewing academic achievement as essential for personal growth and fulfillment.
- Linking performance to self-concept: Connecting one's academic performance to their sense of identity and self-worth.

An environment that fosters academic engagement emphasizes building strong interpersonal relationships, recognizing individuals' value, and providing opportunities for growth. Flexibility in offering chances for personal development and leveraging talents encourages deeper engagement.

According to ***Hashem Al-Abadi*** **and** ***Walaa Joudat*** **(2012)**, academic engagement involves both cognitive and emotional processes. Cognitive processes include an individual's awareness of tasks, their desire to improve performance, and their focus on mastering academic activities. Emotional processes, on the other hand, reflect the individual's emotional involvement in tasks, their connection between task performance and self-concept, and the sense of positivity and motivation towards completing assigned academic duties.

Third: Artificial Intelligence Applications

Artificial Intelligence (AI) is a branch of computer science that focuses on designing computer programs capable of simulating human intelligence. AI enables computers to learn logically and execute tasks that require advanced levels of intelligence. It is considered an automated system with the ability to perform complex tasks through planning, learning, understanding, reasoning, problem-solving, and prediction**.**

Objectives of Using Artificial Intelligence Applications in Education

Recent studies have highlighted the multiple objectives of integrating Artificial Intelligence (AI) applications into education, contributing to the enhancement and development of the educational process. According to the

studies of (**Hassan Abdullah, 2024; Ali Mahmoud, 2023**), AI-powered educational systems make online learning more accessible, affordable, and achievable by providing virtual assistants that support inquiry-based learning and boost learner engagement. AI works alongside human intelligence, playing a vital role in advancing electronic learning environments and improving learning outcomes.

The key objectives of using AI applications in education include:

1. Personalizing Learning: Offering tailored educational experiences that meet the needs and preferences of individual learners, thus enhancing learning effectiveness.
2. Enhancing Student Engagement: Utilizing AI-powered tools to create interactive learning experiences that increase student participation and motivation.
3. Analyzing Student Performance: Empowering teachers to analyze student performance data and behaviors to identify areas requiring additional support.
4. Supporting Special Needs Learners: Facilitating access to educational content for students with special needs through AI applications that process human language rather than programming languages.
5. Developing Scientific Thinking Skills: Strengthening scientific thinking skills by incorporating AI applications in science education.
6. Assisting Teachers with Administrative Tasks: Reducing teachers' workload by automating administrative tasks, allowing more time for instructional activities.
7. Creating Interactive Learning Environments: Designing interactive learning environments that enrich the learning experience and boost student-content interaction.

The **e-learning environment, academic engagement, and artificial intelligence applications** constitute three interconnected pillars that contribute to enhancing the quality of the educational process and enriching the learning experience. The **e-learning environment** serves as the foundation that provides learners with a flexible digital educational space, enabling access to educational content and interaction with instructors and peers through various electronic platforms. This fosters self-directed learning and accommodates individual learner needs. Within this context, **academic engagement** plays a crucial role in enhancing students' interaction with educational content, as it reflects their cognitive and emotional immersion in

academic tasks, thereby improving academic achievement. With technological advancements, **artificial intelligence (AI) applications** have become an essential component in supporting e-learning environments and fostering academic engagement. AI-powered tools offer advanced capabilities for analyzing student performance, personalizing educational content, and providing real-time assistance through virtual tutors. Therefore, integrating these three elements into modern learning environments enhances the effectiveness of the educational process by delivering personalized learning experiences, encouraging active student participation, and supporting their academic and cognitive development.

Research Hypotheses:

1. There are no statistically significant differences at the significance level ($\alpha \geq 0.05$) between the pre-measurement and post-measurement mean scores of the research group in the Academic Engagement Scale as a result of using the adaptive learning environment based on artificial intelligence applications.
2. There is no statistically significant effect at the significance level ($\alpha \geq 0.05$) of using the adaptive learning environment based on artificial intelligence applications on enhancing academic engagement among Educational Technology students.

Research Instruments:

First: Data Collection Tools:

1. A list of criteria for designing an e-learning environment to enhance academic engagement using artificial intelligence applications for Educational Technology students.

The following applications were used in this research:

1. **Undetectable AI** – for text processing.
2. **Leonardo.ai** – for text generation.
3. **Murf** – for voice processing.
4. **Avaturn** – for graphics and animations.
5. **Nolej** – for content creation.
6. **Pictory** – for video processing.
7. **Presentation AI** – for presentation creation.
8. **Gamma** – for interactive presentations.
9. **Quizgecko** – for quiz and assessment creation.

Second: Experimental Treatment Material:

- An e-learning environment through the *Moodle* platform designed to

enhance academic engagement using artificial intelligence applications for Educational Technology students.

Third: Performance Measures:

1. An achievement test (*Prepared by the Researcher)* to assess the cognitive aspect of artificial intelligence applications for Educational Technology students.
2. An Academic Engagement Scale for Educational Technology students.

Research Experiment:

The following is an outline of the procedures followed in selecting the research sample and the steps for enhancing academic engagement using artificial intelligence applications. This includes the preparation of research tools and the implementation of the research experiment according to the ADDIE model for instructional design.

Analysis Phase:

1. Analyzing general objectives.
2. Analyzing learner characteristics.
3. Analyzing the dimensions of academic engagement using artificial intelligence applications.
4. Analyzing educational tasks and activities.

Design Phase:

The design process aims to set the conditions and specifications for learning resources and processes, including the following:

5. Defining learning objectives.
6. Determining content.
7. Organizing content elements.
8. Selecting instructional media.
9. Establishing design principles.
10. Designing the flowchart.

Development Phase:

11. Adapting the learning environment.
12. Integrating the environment with AI-related internet services.
13. Sharing educational resources and links.

Implementation Phase:

14. Presenting the e-learning environment evaluation form to a group of specialists before the actual application.
15. Developing the learning environment content.
16. Uploading the environment.

Evaluation Phase:

17. Assessing students' learning outcomes from the e-learning environment.
18. Evaluating the online learning environment.

Pilot Study:

19. A pilot study was conducted with 80 first-year students from the Department of Educational Technology, Faculty of Specific Education, Minia University. It revealed several challenges, including:
20. Students' lack of prior training in using the *Moodle* platform and unfamiliarity with its features and learning capabilities.
21. Students' limited knowledge of the interactive and communication tools available on *Moodle* and their inability to use them effectively.
22. The researcher addressed these issues by organizing sessions to train students on how to use the *Moodle* platform, interact with its tools, and explore various learning resources. A preliminary practice session was also conducted to familiarize students with the platform before starting the main research experiment.

Quasi-Experimental Research Design:

The research adopted a quasi-experimental design using a four-group factorial model (4x1) with pre- and post-testing. The research tools were applied to a single research group prior to the experiment, followed by the implementation of the research experiment using artificial intelligence applications, and then post-testing of the research tools.

The experimental treatment of the study proceeded through several stages, as outlined below:

1. **Selection of the Research Group:**
   The research group was selected from first-year students in the Department of Educational Technology at the Faculty of Specific Education, Minia University. These students were targeted for enhancing academic engagement using artificial intelligence applications, aligning with the research objectives. They had no prior exposure to the dimensions of academic engagement through AI applications. This group, consisting of 50 male and female students, was chosen randomly.
2. **Research Experiment Procedures**:
   The research experiment was conducted through the following steps:

- **Administrative Approvals**:
  The necessary administrative approvals were obtained to conduct the

research with the selected group.

- **Research Setting:**
  The experiment took place in one of the computer labs within the Department of Educational Technology at the Faculty of Specific Education, Minia University.
- **Pre- and Post-Application of Research Tools**:
  - **Achievement Test**: The achievement test, designed to assess the cognitive aspects of academic engagement dimensions based on AI applications, was administered to the research group both before and after the experiment.
  - **Academic Engagement Scale**: The academic engagement scale was also applied pre- and post-experiment to measure any changes in students' engagement levels.
- **Ensuring Group Equivalence:**
  The equivalence of the research group was verified by comparing pre- and post-test results using the research tools, ensuring the reliability of the experiment's outcomes.

Pilot Experiment for Research Tools:

Pilot Sample:

The pilot sample consisted of 80 students from the Educational Technology Department at the Faculty of Specific Education, Minia University.

Research Tools:

First: Psychometric Properties of the Cognitive Achievement Test for Artificial Intelligence Applications (Prepared by the researcher, 2025)

1. **Validity:**

A. Internal Consistency (Homogeneity):

The internal consistency of the cognitive achievement test for artificial intelligence applications was calculated as an indicator of validity and the soundness of the test structure. Pearson's correlation coefficient was used to measure the correlation between individual item scores and the total test score. Items that did not show significant correlations with the overall test score were excluded. The results are presented in Table (1).

Table (1):
Correlation Coefficients between Individual Item Scores and the Total Score of the Cognitive Achievement Test (N = 80)

Item-Total Correlation	No	Item-Total Correlation	No	Item-Total Correlation	No	Item-Total Correlation	No
**0,675	46	**0,573	31	**0,560	16	**0,534	1
**0,684	47	**0,542	32	**0,516	17	**0,509	2
**0,710	48	**0,529	33	**0,522	18	**0,621	3
**0,605	49	**0,533	34	**0,582	19	**0,777	4
**0,671	50	**0,545	35	**0,572	20	**0,725	5
**0,707	51	**0,638	36	**0,631	21	**0,712	6
**0,586	52	**0,526	37	**0,554	22	**0,790	7
**0,704	53	**0,567	38	**0,681	23	**0,572	8
**0,632	54	**0,559	39	**0,636	24	**0,505	9
**0,702	55	**0,511	40	**0,617	25	**0,539	10
**0,783	56	**0,628	41	**0,628	26	**0,555	11
**0,748	57	**0,569	42	**0,532	27	**0,529	12
**0,666	58	**0,602	43	**0,556	28	**0,507	13
**0,524	59	**0,524	44	**0,555	29	**0,601	14
**0,627	60	**0,562	45	**0,653	30	**0,553	15

Results of Internal Consistency for the Cognitive Achievement Test on Artificial Intelligence Applications

The (**) symbol indicates that the correlation coefficient (r) is statistically significant at the 0.01 level.

As shown in Table (1), the internal consistency values for the test items ranged from (0.507 to 0.790), indicating that all items have a positive and statistically significant correlation at the 0.01 level with the total test score, based on a sample of 80 students from the Department of Educational Technology, Faculty of Specific Education, Minia University, with 99 degrees of freedom.

Accordingly, all 60 items were retained, as they showed a positive and significant correlation with the total score, reinforcing the internal consistency validity of the test.

Thus, it can be concluded that the test demonstrates a high degree of validity, supporting its reliability as a research instrument for measuring cognitive achievement in artificial intelligence applications, in line with the current study's objectives.

Secondly – Difficulty, Ease, and Discrimination Indices for the Cognitive Achievement Test on Artificial Intelligence Applications

Table (2):
Difficulty, Ease, and Discrimination Indices for the Cognitive Achievement Test (N = 80)

Discrimination Index	Difficulty Index	Ease Index	No	Discrimination Index	Difficulty Index	Ease Index	No
0.240	0.60	0.40	31	0.247	0.55	0.45	1
0.240	0.60	0.40	32	0.210	0.70	0.30	2
0.240	0.60	0.40	33	0.247	0.45	0.55	3
0.247	0.55	0.45	34	0.227	0.65	0.35	4
0.247	0.55	0.45	35	0.240	0.60	0.40	5
0.227	0.65	0.35	36	0.247	0.55	0.45	6
0.240	0.60	0.40	37	0.250	0.50	0.50	7
0.250	0.50	0.50	38	0.210	0.70	0.30	8
0.247	0.55	0.45	39	0.210	0.70	0.30	9
0.240	0.60	0.40	40	0.227	0.65	0.35	10
0.247	0.55	0.45	41	0.250	0.50	0.50	11
0.227	0.65	0.35	42	0.210	0.70	0.30	12
0.227	0.65	0.35	43	0.227	0.65	0.35	13
0.240	0.60	0.40	44	0.250	0.50	0.50	14
0.247	0.55	0.45	45	0.227	0.65	0.35	15
0.250	0.50	0.50	46	0.250	0.50	0.50	16
0.250	0.50	0.50	47	0.227	0.65	0.35	17
0.240	0.60	0.40	48	0.250	0.50	0.50	18
0.247	0.55	0.45	49	0.250	0.50	0.50	19
0.240	0.60	0.40	50	0.250	0.50	0.50	20
0.247	0.55	0.45	51	0.250	0.50	0.50	21
0.240	0.60	0.40	52	0.210	0.70	0.30	22
0.227	0.65	0.35	53	0.250	0.50	0.50	23
0.247	0.55	0.45	54	0.227	0.65	0.35	24
0.250	0.50	0.50	55	0.250	0.50	0.50	25
0.247	0.55	0.45	56	0.250	0.50	0.50	26
0.247	0.55	0.45	57	0.210	0.70	0.30	27
0.227	0.65	0.35	58	0.250	0.50	0.50	28
0.240	0.60	0.40	59	0.247	0.55	0.45	29
0.240	0.60	0.40	60	0.247	0.55	0.45	30

It is evident from Table (2) that the Ease Index values for the cognitive achievement test on artificial intelligence applications ranged from 0.30 to 0.55, while the Discrimination Index values ranged from 0.210 to 0.250. Consequently, it can be concluded that all the Ease, Difficulty, and Discrimination indices fall within the acceptable range,

indicating the appropriateness of the test items for measuring cognitive achievement in artificial intelligence applications.

Third: Reliability

The reliability of the cognitive achievement test on artificial intelligence applications was verified using Cronbach's alpha coefficient, with a reliability coefficient of 0.920.

Table (3):

Reliability coefficient of the cognitive achievement test on artificial intelligence applications (N = 80)

It is evident from Table (3) that the reliability coefficient of the cognitive achievement test on artificial intelligence applications is high, exceeding 0.7. Therefore, it can be concluded that this test is reliable and valid for achieving the objectives of the current research.

Second: Psychometric Properties of the Academic Engagement Scale *(Prepared by/ Shaimaa Mahmoud Salman, 2022)*

First: Validity

A. Internal Consistency:

The internal consistency of the Academic Engagement Scale was calculated as an indicator of validity and the structural soundness of the scale, using Pearson's correlation coefficient for raw scores. Items that did not show statistically significant correlations with their respective subscale scores, as well as subscales that did not significantly correlate with the total score of the scale, were excluded. The results are shown in Tables (3).

Table (3):

Correlation coefficients between item scores and their corresponding subscale scores (N = 80)

Correlation Coefficient with Subscale	No.	Correlation Coefficient with Subscale	No.	Correlation Coefficient with Subscale	No.	Correlation Coefficient with Subscale	No.
Dimension 4 - Work as Life's Focus		**Dimension 3 - Self-efficacy Skills**		**Dimension 2 - Perseverance**		**Dimension 1 - Flow**	
**0,537	27	**0,666	19	**0,682	10	**0,612	1
**0,515	28	**0,645	20	**0,523	11	**0,581	2
**0,637	29	**0,598	21	**0,509	12	**0,559	3
**0,683	30	**0,582	22	**0,506	13	**0,600	4
**0,566	31	**0,506	23	**0,545	14	**0,534	5
**0,562	32	**0,590	24	**0,552	15	**0,527	6

Correlation Coefficient with Subscale	No.	Correlation Coefficient with Subscale	No.	Correlation Coefficient with Subscale	No.	Correlation Coefficient with Subscale	No.
Dimension 4 - Work as Life's Focus		**Dimension 3 - Self-efficacy Skills**		**Dimension 2 - Perseverance**		**Dimension 1 - Flow**	
**0,670	33	**0,617	25	**0,530	16	**0,560	7
**0,650	34	**0,584	26	**0,555	17	**0,569	8
**0,717	35			**0,505	18	**0,554	9
**0,685	36						

All values are statistically significant at the (0.01) level, as indicated by ().** It is evident from Table (4) that the internal consistency values of the items ranged from (0.505 to 0.717),** indicating that all items showed a positive and statistically significant correlation at the (0.01) level with the total score of their respective dimension. This was based on a sample of 80 students from the Educational Technology Department at the Faculty of Specific Education, Minia University, with 99 degrees of freedom.

The finalized scale consisted of 36 valid items suitable for measuring Academic Engagement.

Table (4)

Correlation coefficients between the dimensions of the Academic Engagement Scale and the total score of the scale (N = 80).

Correlation coefficient with the total score of the scale	Dimensions
**0,801	Dimension 1 - Flow
**0,858	Dimension 2 - Perseverance
**0,862	Dimension 3 - Self-efficacy Skills
**0,888	Dimension 4 - Work as Life's Focus

It is evident from Table (4):

The internal consistency values for the dimensions ranged from (0.801** to 0.888**), indicating that all dimensions have a positive and statistically significant correlation at the (0.01) level with the total score of the scale. Therefore, it can be concluded that the Academic Engagement Scale for university students, as applied in the current research, possesses a high degree of internal consistency validity for both its items and dimensions, ensuring its suitability for achieving the research objectives.

Third: Reliability

The reliability of the Academic Engagement Scale as a whole and its various dimensions was verified using Cronbach's alpha coefficient. The results are presented in Table (5).

Cronbach's Alpha Coefficient	Number of Items	Scale
0,868	9	Dimension 1 - Flow
0,893	9	Dimension 2 - Perseverance
0,857	8	Dimension 3 - Self-efficacy Skills
0,921	10	Dimension 4 - Work as Life's Focus
0,957	36	Academic Engagement Scale as a Whole

It is evident from Table (5) that the reliability coefficients of the Academic Engagement Scale as a whole and its various dimensions ranged from (0.857 to 0.957), which are high values exceeding (0.7). Therefore, it can be concluded that this scale demonstrates a high degree of reliability and is suitable for achieving the objectives of the current research.

Based on the above, it is clear that the Academic Engagement Scale, with its various dimensions, possesses a high level of psychometric properties (validity and reliability). Accordingly, the researcher is confident in using the Academic Engagement Scale to achieve the objectives of the current study.

Interpretation of Research Results:

- **Research Results and Discussion:**
- **Results and Discussion of the First Hypothesis:**

The first hypothesis states: "There are statistically significant differences at the level of ≤ (0.05) between the mean scores of the pre-test and post-test measurements of the experimental group in the cognitive achievement test for artificial intelligence applications, in favor of the post-test."

To verify this hypothesis, the researcher used the "T-test" for the significance of differences between the means of two related samples, known as the "Paired Samples Test" (**Rabie, 2007, p. 143; Mansi & Al-Sharif, 2014, pp. 269-284).** The results are presented in Table (6).

Table (6): Results of the Differences Between the Mean Scores of the Pre-test and Post-test Measurements of the Experimental Group in the Cognitive Achievement Test for Artificial Intelligence Applications (at n = 80).

Effect Size Cohen's F	Significance Level	Degrees of Freedom	t-value	Standard Deviation	Mean	Dependent Variable	Group
0,733 Large	0,00	79	**14,73	8,30	34,17	Cognitive Achievement Test	Pre-test
				5,96	51,11		Post-test

This means that the t-value is significant at the (0.01) level.

It is evident from Table (6) the following:

1. There are statistically significant differences at the ≤ (0.05) level between the mean scores of the pre-test and post-test for the experimental group in the cognitive test of artificial intelligence applications, in favor of the post-test.
2. To calculate the effect size or effectiveness, Cohen's formula was used according to the following equation:

Results even with different scales and units of measurement. Effect sizes in this context are classified as small, medium, and large. At a significance level of 0.0005 and test power, the effect sizes for t-tests and ANOVA can be presented in the following table:

Table (7)

Standardized Effect Size for t-test and ANOVA at the Significance Level … and Test Power (8)

Cohen (1988) identified standardized effect size measures, which are useful for comparing study results even with different scales and units of measurement. Effect sizes in this context are classified as small, medium, and large. At a significance level of 0.0005 and test power, the effect sizes for tests and ANOVA can be presented in the following table:

The Test Used	Effect Size	Negligible	Small	Medium	Large
t-test	D	Less than 0.20	0.20-0.50	0.50-0.80	0.80 large
One-Way ANOVA	f	Less than 0.10	0.10-0.25	0.25-0.40	0.40 large

(Rabie Abdu Ahmed Rashwan, 2020, p. 122)

It is evident from the previous table (7) that:

- The effect size value according to Cohen equals (0.733), indicating a large effect size. This confirms the effectiveness of the e-learning environment in enhancing academic engagement using artificial intelligence applications.

Discussion and Interpretation of the First Hypothesis Results

1. The results presented in Table (7) revealed statistically significant differences at the ≤ (0.05) level between the mean scores of the pre-test and post-test for the experimental group in the cognitive test of artificial intelligence applications. The mean score in the post-test was higher compared to the pre-test. Additionally, Cohen's effect size value was (0.733), indicating a large effect size, which reflects the effectiveness of the e-learning environment in enhancing the cognitive

aspect of artificial intelligence applications.

2. These results can be interpreted through the following factors:
3. The statistically significant differences between the pre-test and post-test suggest that the e-learning environment positively contributed to improving students' knowledge of artificial intelligence applications.
4. The increase in the post-test mean score confirms that the designed educational environment was effective in delivering cognitive content and enhancing understanding.
5. Cohen's value (0.733) indicates a large effect size, meaning that the educational impact of this e-learning environment was not marginal but rather strong and evident in improving cognitive aspects.
6. The results support the educational hypothesis that integrating artificial intelligence applications into e-learning environments enhances student engagement, raising their level of concentration and participation in learning.
7. Artificial intelligence provides an adaptive learning environment that responds to students' individual needs, contributing to better comprehension and knowledge.
8. The e-learning environment offered continuous feedback, helping students correct their mistakes and reinforce information more quickly.
9. The environment encouraged student interaction and participation, which led to improved cognitive achievement compared to traditional learning.

Based on these results, it can be concluded that the e-learning environment based on artificial intelligence applications significantly contributed to the development of cognitive achievement. This underscores the importance of utilizing such environments in various training and educational programs.

Results and Discussion of the Second Hypothesis:

The hypothesis states that "There are statistically significant differences at the ≤ (0.05) level between the mean scores of the pre-test and post-test for the experimental group on the academic engagement scale in favor of the post-test."

To verify this hypothesis, the researcher used the "T-test" for the significance of differences between the means of two related groups, known as the "Paired Samples Test." The results are presented in Table (8).

Table (8)
Results of the differences between the mean scores of the pre-test and post-test for the experimental group on the academic engagement scale (n = 80).

Effect Size Cohen's F	Significance Level	Degrees of Freedom	t-value	Standard Deviation	Mean	Dependent Variable	Group
0,857 Large	0,00	79	**21,77	23,55	135,55	The Academic Engagement Scale as a Whole	Pre-test
				6,19	162,25		Post-test

It is indicated that the value of (t) is significant at the (0.01) level.
Table (8) shows the following:

1- There are statistically significant differences at ≤ (0.05) between the mean scores of the pre-test and post-test measurements for the experimental group on the Academic Engagement Scale, in favor of the post-test.
2- 2- The effect size value (Cohen's d) is (0.857), indicating a large effect size. This confirms the effectiveness of the electronic environment in achieving academic engagement.

Discussion and Interpretation of the Second Hypothesis Results

The results presented in Table (8) indicate the presence of statistically significant differences at the ≤ 0.05 level between the pre-test and post-test mean scores of the experimental group on the Academic Engagement Scale, favoring the post-test. The mean score increased significantly after the experiment, and the Cohen's d effect size was 0.857, indicating a large effect size. This highlights the effectiveness of the electronic learning environment in enhancing academic engagement among learners.
These findings can be interpreted based on the following factors:

1. The statistically significant differences between the pre-test and post-test confirm that the electronic learning environment had a positive impact on improving students' academic engagement levels.
2. The increase in the post-test mean score suggests that the experiment enhanced students' interaction, focus, and involvement in learning activities.
3. The Cohen's d value (0.857) indicates a substantial effect, signifying that the electronic environment had a clear and significant impact

on academic engagement.

4. The results support the effectiveness of AI-powered applications in creating a stimulating learning environment, which enhances students' engagement in the learning process.
5. The adaptive learning environment provided content that aligned with students' needs, improving their concentration and persistence in learning.
6. Continuous interaction and instant feedback within the electronic environment strengthened students' sense of achievement and motivation to continue learning.
7. The experiment promoted active learning by engaging students in interactive activities, leading to a higher level of academic engagement.

Based on these findings, it can be concluded that the AI-driven electronic learning environment significantly contributed to enhancing students' academic engagement, underscoring the importance of leveraging such technologies in education to create a more effective and immersive learning experience.

Recommendations:

In light of the current research findings, the researcher recommends the following:

1. Utilizing AI-Supported E-Learning Environments to deliver personalized educational content that meets individual students' needs and motivates them to achieve academic engagement.
2. Implementing Adaptive Learning Technologies to analyze student data and tailor learning pathways according to their learning styles and interests.
3. Integrating AI Tools such as intelligent tutoring systems to provide instant support, enhancing students' focus and academic involvement during the learning process.
4. Activating Smart Assessment Tools to monitor academic engagement levels and generate real-time reports that help improve student performance.
5. Designing Interactive Learning Activities supported by AI technologies to foster collaboration and interaction among students within an e-learning environment.

Suggested Research Topics:

Based on the current research findings, the researcher suggests the following topics for future studies:

1. The Impact of AI-powered Electronic Learning Environments on Enhancing Academic Engagement among Educational Technology Students.
2. The Effectiveness of AI Tools in Improving Focus and Academic Engagement within Electronic Learning Environments.
3. Designing an AI-based Adaptive Learning System to Stimulate Interaction and Academic Engagement among Higher Education Students.
4. The Impact of AI-driven Learning Analytics on Promoting Academic Engagement among Educational Technology Students.
5. The Role of AI Applications in Developing E-learning Strategies to Enhance Academic Engagement in Digital Learning Environments.

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