Generative AI Technology and Creativity in Smart Digital Content Production among University Students

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***Abstract*—Recently, there has been significant development in the use of generative Artificial Intelligence (AI), particularly concerning education and digital content production. AI has become a useful tool for improving creativity skills that lets teachers create and design advanced digital material to help their students learn more efficiently. Still, many academic institutions continue to rely on old-school approaches that put hypothetical academic goals first, thereby stifling the development of students' creative thinking abilities. This research aimed to fill this transitional gap by looking into the impact of generative AI on the development of digital creativity skills among master's degree students enrolled in the "Computers in Education" course at King Khalid University. The study used a quasi-experimental approach with a two-group design: an experimental group of 32 male and female students who received training on generative AI platforms and a similar control group taught using traditional methods. Digital creativity skills were measured across four main dimensions: digital fluency, digital resilience, digital authenticity, and digital vitality. The results of the statistical analysis showed notable differences in favor of the experimental group, showing that generative AI played a huge role in enhancing students' skills in producing creative digital content. The impact of using this technology also positively impacted their developing digital creativity skills. The study recommended integrating generative AI into educational curricula to improve digital creativity and provide interactive learning environments powered by AI to meet the needs of the digital labor market.**

***Keywords*—generative artificial intelligence, digital creativity, smart content design, technology in education, interactive learning**

I. Introduction

The reliance of global institutions on Artificial Intelligence (AI) technology may lead to a major change in many fields and most particularly in the field of education. The generative artificial intelligence Chat Generative Pre-Trained Transformer (ChatGPT) and its various applications represent one of the methods that can help in knowing what the learner can and cannot do. Generative artificial intelligence technology can also design smart electronic content and present it to learners in a smart, interactive way according to their abilities and needs. Thus, generative artificial intelligence technology helps in knowing the abilities of each learner and provides assistance and clarification for any part of the educational content that is not understood by the student. Thus, generative artificial intelligence technology can help in developing the learner's various skills with high efficiency.

AI is one of the most powerful technological innovations available to humanity at the present time. As a result, the United States of America has paid attention to this vital field, with the White House issuing a document confirming the strategic importance of artificial intelligence, thereby opening new horizons for individuals and institutions in fields such as science, medicine, communications, and information technology, among others. Therefore, the US administration emphasizes the importance of accelerating artificial intelligence research in order to create, innovate, and lead in this vital field. Additionally, China has also developed an ambitious plan to benefit from artificial intelligence, aiming to become the world leader in this field by 2030 [1].

Despite the widespread use of generative AI technology in various fields, including digital content creation, there is a lack of studies exploring the impact of this technology on creativity in smart digital content production among university students. While some research has addressed the technical uses of AI in other fields, few studies have focused on the gaps between AI technological capabilities and the ability of university students to use these tools in creative contexts. This study highlights the need to understand the relationship between generative AI and creativity in digital content production among students, focusing on the challenges and opportunities that may arise when integrating this technology into academic thinking and creativity processes [2].

Artificial intelligence technologies will boost workplace safety and productivity at the same time. In this regard, the McKinsey report indicated that artificial intelligence has the ability to add 1.2% to the global GDP annually, and it is expected that artificial intelligence will contribute about 13 trillion dollars to the global economy over the next decade [3].

According to certain studies, educational institutions' lack of interest in practical and design aspects and their strong emphasis on academic achievement alone are the reasons behind students' poor levels of creative development of ideas and project presentation that aims to solve problems in both everyday life and the future [4]. Other studies point to a lack of interest by universities in instilling a culture of digital creativity among their students, the absence of strategies that motivate creative students and encourage their initiatives, and the fact that the vision and mission of most universities do not encourage the development of creativity skills in digital products and businesses among students [5].

Through the OpenAI platform, the ChatGPT application can be used to help students organize their thoughts and

generate and plan new and creative ideas to enhance and develop their creativity and innovation skills. Students can also cooperate with the teacher to discuss and analyze the ideas and information obtained from generative artificial intelligence technology and then obtain deep and useful ideas and information. It can also contribute significantly to producing creative ideas that serve society. Moreover, the learner can also use ChatGPT to create articles on specific topics, design presentations, record and edit audio, generate illustrative images, design avatars on a specific topic, design integrated e-lessons, and many other creative projects; therefore, it can be said that the ChatGPT platform is a platform that prepares individuals for future professions. This is what was shown in the study by Wazzan [6]. In this regard, the study concluded that ChatGPT technology can be used to evaluate the credibility of learning content and develop creative thinking skills by having the teacher design digital content for a specific topic; then, students evaluate the information held there and verify its accuracy. It can also be used to improve students' writing and generate innovative ideas and information.

Sok and Heng [2] also concluded that it is an opportunity to supply educational support and evaluate learning, creativity, and innovation.

Another study, this time carried out by Shanab and Fayad [7], concluded that generative artificial intelligence plays a significant role in enhancing the creativity of designers and supporting them in design and advertising and in improving the quality of their production. It can also analyze data and supply suggestions for proper modifications. The study recommended the need to receive help from generative artificial intelligence applications in improving advertising photographs and enriching the creative design of advertising design elements. Indeed, the digital design process is affected by the prodigious technological progress in the field of artificial intelligence by creating a semi-realistic match for the design before bringing it to reality because digital design allows for the simulation of reality and represents it with extreme vitality and accuracy, in addition to providing a suitable environment for digital inspiration and creativity through the use of modern technology in design [8].

Digital design, a form of visual communication, is one of the most important terms in the current era; it refers to what is created and produced with digital technology and is mostly displayed on the screen in a world where the importance of using digital technology, and especially generative artificial intelligence, is increasing. Digital design is based on creating visual content to communicate messages and visual concepts that convey solutions and ideas to beneficiaries and influence them; it is a design for smart visual communication [9].

In this regard, Al-Hadi [10] pointed out that training traditional AI systems by providing them with large amounts of data to identify patterns and enable them to perform specific tasks can help individuals and organizations alike. However, the generative AI program ChatGPT goes a step further, using advanced and complex systems and models to generate new outputs in the form of a model, graphic, text, or audio based on natural human language signals. Therefore, generative AI models and their applications can be used in text generation, video generation, programming code generation, language translation, data generation and representation, and more.

Lo [11] points out an important aspect of the current time, which is that the world and the labor market do not need more graduates with good grades; rather, they need learners who have a thirst for knowledge, are self-motivated and creatively qualified to see the challenges of educational, economic, and industrial problems in the world and want to solve them.

On the other hand, believe that university education curricula focus on superficial content design skills and students' interest in obtaining the main ideas of electronic content without delving into the design of educational electronic content. Therefore, the call came for the necessity of making students think and innovate instead of reading the content superficially or writing down the most important notes included in the educational content. Therefore, many countries have turned to adopting creative education in their educational systems in order to raise their generations on creativity as the main driver of economic and social development [2].

Every year in the United States of America, for example, one week is designated for individuals to practice creative work. In addition, universities in America offer advanced educational programs in the field of digital creativity. In Japan, universities have been given independence in creative development and reducing the gap between education outcomes and labor market needs [12].

Although a number of previous studies [7, 8, 13, 14] have emphasized the importance of digital creativity in light of the rapid developments in artificial intelligence and technology, there is a continuing need for more critical analysis of the effectiveness of modern tools and technologies, such as generative AI, in enhancing and developing this type of creativity among students.

Through an analytical review of earlier studies, research gaps were identified, including a focus on theoretical aspects without a rigorous applied study that clearly measures the impact of these technologies. It also became clear that earlier studies rarely addressed direct conclusions that support the current approach to this study, which this study seeks to address through a precise and specific methodological design to measure the impact of using generative AI on developing digital creativity in a practical and direct manner.

Based on the aforementioned problems and phenomena and on the previous studies described above, it becomes clear that the interest of university institutions in the field of creativity in creating smart digital content for any academic content and designing creative projects and ideas has become essential for the success of the educational institution, especially in light of the tremendous technological development of generative artificial intelligence technology, which plays a major role in serving the individual, the institution, and society. As for the negativity and weakness in designing and producing creative digital products and being satisfied with only browsing websites, listening to lectures, taking notes, and saving them for the final exam, this is considered a superficiality and killing of digital creativity among university students, especially in the era of generative artificial intelligence.

A. Research Problem

The educational process in many academic institutions suffers from the adoption of traditional educational models

that focus primarily on academic achievement, while neglecting to develop students' creative thinking skills. This educational approach may limit their ability to generate the latest ideas or offer innovative solutions to life's problems. Despite the growing need for digital creativity in the modern era, the weak integration between curricula and strategies that promote creativity is still an obstacle to developing students' skills in this area. Therefore, it is necessary to study the impact of these educational models on student creativity levels and explore ways to update them to contribute to developing the creative capabilities required in the future digital work environment.

The stereotype in universities is that creativity is taught, not practiced, and the majority of learners spend their time within the framework of "usual learning", which means that their ideas lie within this framework that includes definitions, knowledge, traditional information, and simple digital skills without interest in generating new creative ideas [15].

On the other hand, Schrum and Levin [16] indicate that the majority of students are interested in the social communications they make through web-based digital platforms, and despite the students' daily use of these digital tools, educational institutions are still slow in training university students to use these tools in the smart design of educational content, even though they may help them integrate and innovate.

In this regard, the study of Ahmed [17] focused on examining the difficulties faced by graduates of Arab universities when integrating into the labor market. The study concluded that the current labor market and its future prospects do not accommodate the outputs of higher education institutions. This is primarily due to the lack of compatibility of the outputs of these institutions in terms of quantity and quality with the labor market, as universities are interested in filling minds with dense knowledge and information and neglecting the skills that aim to develop creativity and digital innovation.

The number of people with digital creativity skills in Arab higher education institutions is small, as Arab universities are still unable to build new generations of technological innovators who lead the development process in Arab national economies [4]. Halaweh [14] confirms this, as higher education institutions do not provide the necessary flexibility to nurture talent, creativity, and digital innovation. Moreover, they also have a major deficiency in providing a creative educational environment for students, and the traditional educational model is one of the most prominent obstacles to creativity and innovation.

In this regard, Moussa and Bilal [18] indicate that Arab universities do not care much about the field of digital creativity but rather focus on knowledge related to test performance only or the culture of deposit, not creativity. They also confirm that most digital products only work to convert traditional content into a digital format. As a result, learners believe they have the ability to be digitally creative, but in reality, they know little about it. Al-Mahmadi [13] focuses on artificial intelligence and digital creativity and points out that there is a large group of photo, video, and music editing applications that provide and grant an unlimited amount of creativity and digital modification, despite that many individuals feel it is difficult to deal with these applications due to the lack of appropriate guidance and assistance.

Generative AI is one of the latest technologies that has revolutionized many fields, especially in education and digital content production [14]. However, earlier studies show that most research has focused on the use of generative AI in areas such as problem-based learning and data analysis without delving into its direct impact on graduate students' digital creativity skills. Therefore, the main research gap that this research addresses is the lack of studies that compare traditional and smart learning methods using generative AI in a structured academic environment while analyzing the impact of this technology on the development of smart digital content design and production skills [2].

Earlier studies indicate that most higher education institutions focus on providing students with theoretical knowledge while neglecting the development of practical and creative skills required for the labor market [7]. Also, a small percentage of students actively take part in the digital content industry, as the vast majority rely on consuming information rather than producing it [11]. Therefore, this research seeks to bridge this gap by testing the impact of generative AI in enhancing digital creativity skills through a quasi-experimental experiment comparing an experimental group that received training using generative AI platforms and a control group that relied on traditional methods.

Based on the above, this research is not limited to analyzing the research gap only but rather contributes to supplying a new vision for developing university curricula by employing generative artificial intelligence as a tool to enhance digital creativity among university students. It also provides practical recommendations based on scientific evidence, such as the necessity of integrating generative artificial intelligence into digital content design courses and developing interactive learning environments that use this technology to improve the quality of academic and professional outcomes. Thus, this research is a qualitative addition to the scientific literature on employing generative artificial intelligence in higher education and the smart digital content industry.

A group of graduate students were interviewed to explore their skill levels in designing and producing creative digital content. The results of these interviews revealed that 90% of students face challenges in developing creative digital content, whether in terms of ideation, design, or implementation. They also showed that the lack of modern interactive tools and the reliance on traditional teaching methods are obstacles to developing their creative skills in this area. These preliminary findings underscore the need for a deeper study to evaluate the impact of generative AI techniques on improving these skills.

From the above, the problem of the current research was identified as the weakness of the skills of designing and producing creative digital content among university students. Therefore, the current research looks to address this weakness by using generative artificial intelligence technology to develop creativity skills in the production of digital educational content.

B. Research Questions

The current research attempted to answer the following

question:

What is the effect of using generative artificial intelligence technology on developing creativity skills in creating smart digital content among graduate students?

C. Research Hypotheses

The current research tried to verify the validity of the following hypotheses:

There is a statistically significant difference at the level of 0.05 between the average scores of the experimental group and the control group in the post-application of the digital creativity test in the "Computers in Education" course for postgraduate students in favor of the experimental group.

D. Research Objective

The current research aimed to develop creativity in designing and producing smart digital content in the "Computers in Education" course among graduate students at the College of Education by using generative artificial intelligence technology with its various platforms. It also aims to encourage students to produce creative digital designs.

E. Importance of the Research

This study is of great importance in light of the rapid developments in generative AI technology and its applications in higher education. By exploring the impact of this technology on creativity in digital content production among graduate students, the study highlights how to integrate technological innovations into the educational process, which may contribute to improving teaching and learning strategies. The results of this study can also provide valuable insights for educational policymakers, helping to reconsider traditional pedagogical models and promote the use of AI technologies to support creativity and skill development among students. Therefore, this study can contribute to guiding educational policies towards more effective adoption of modern technologies, enhancing students' abilities to think critically and creatively in digital learning environments.

The importance of the study lies in the following points:

1) Supplying practical evidence of the effectiveness of generative AI techniques in enhancing students' digital creativity skills.
2) Guiding educational decision-makers toward integrating AI applications into curricula and training programs.
3) Supporting educational policymakers in adopting modern strategies that keep pace with the requirements of the digital age.
4) Motivating educational institutions to supply modern technological environments that foster creative and innovative thinking.
5) Contributing to the development of educational policies and launching future initiatives to enhance students' digital and creative skills.
6) The importance of generative AI is not limited to the academic environment but extends to many professional fields such as digital marketing, creative design, and content production, enhancing students' opportunities in the digital job market. Empowering students to use this technology not only helps improve their academic skills but also prepares them to use AI tools in developing digital marketing strategies, designing creative products, and creating professional digital content that meets the needs of various sectors. Therefore, integrating generative AI into education contributes to preparing students for the requirements of the growing digital economy and provides them with a competitive advantage in multiple fields outside of academia.

F. Research Determinants

The current research was limited to the following skills: professional video design, logo design, packaging and product design, electronic mind map design, professional website design, smartphone app design, and smart electronic content design.

The current research was limited to the following determinants:

1) The course "Computers in Education – 6000Tech"
2) Digital creativity skills: digital fluency, digital flexibility, digital originality, and digital vitality.
3) This current study was limited to graduate students because the college in question does not offer undergraduate programs, focusing exclusively on master's and doctoral programs.
4) Accordingly, all academic courses and research programs at the college are geared toward qualifying graduate students, making them the natural target group for the study without the need to include undergraduate students.

II. Literature Review

Generative AI is a type of AI technology that can be used to design content such as texts, images, videos, music, programming codes for websites and electronic applications, data processing, etc. Generative AI is associated with terms such as machine learning, deep learning, artificial intelligence, and guided learning, as shown in Fig. 1 [19].

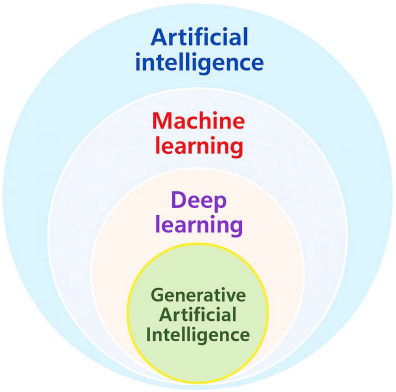

Fig. 1. The relationship between generative AI, deep learning, machine learning, and artificial intelligence.

Fig. 1 shows that generative artificial intelligence is a subfield of deep learning, which uses deep neural network techniques to simulate the human ability to create and design original and innovative data or content. Deep learning is a subfield of machine learning that uses several hidden layers in neural networks to solve complex problems. Machine learning is a subfield of artificial intelligence that is concerned with learning patterns from available data to make predictions or decisions based on new data without explicit programming. Artificial intelligence is a field of computer science that focuses on building systems capable of

performing tasks that usually require human intelligence, such as learning, reasoning, and self-development.

Therefore, generative artificial intelligence stands for a qualitative shift in how machines interact with users and generate new and innovative content such as texts, images, and video clips. This was clearly proven by the victory in a 2022 art competition of an image created by generative artificial intelligence and the positive reactions to it, thereby confirming that the efforts made to develop the field of generative artificial intelligence have a significant impact on the future of institutions and the technical and economic future. Zakrallah [3] and Ritter *et al*. [20] pointed out that generative AI helps in designing an AI-powered application and designing the user experience, i.e., generative AI refers to AI models and algorithms that can generate original content based on the data on which they were trained.

The study conducted by Zhai [21] concluded that it is necessary to design educational tasks and activities that integrate artificial intelligence, enhancing students' critical and creative thinking skills and helping them find solutions to real-life problems in society.

The results of the study conducted by Halaweh [14] also showed that generative artificial intelligence tools such as ChatGPT provide a supportive environment for creativity by proposing new ideas and stimulating students' critical thinking processes. The study also demonstrated that using these tools in the educational process enhances learners' ability to produce innovative content and analyze alternatives more efficiently.

The study presented by Sok and Heng [2] focused on analyzing the role of generative artificial intelligence in supporting problem-based learning in higher education and concluded that this technology contributes significantly to developing students' critical and creative thinking skills by providing unconventional solutions and saving time for brainstorming.

A study by Lo [11] concluded that generative AI provides effective tools in graphic design and digital creativity, allowing designers to come up with innovative solutions faster than traditional methods. The study demonstrated that using these tools can enhance designers' ability to deliver unique designs and automatically analyze feedback, contributing to improved production quality. Furthermore, a study by Shanab and Fayad [7] examined the role of generative AI in supporting designers and digital creators in improving their visual and advertising production. The study concluded that generative AI tools enable data analysis and design suggestions that enhance creativity and support designers in making informed decisions.

The study conducted by Manavis *et al*. [8] focused on the importance of generative artificial intelligence in improving self-learning skills by providing educational suggestions that adapt to learners' needs. The study concluded that the use of artificial intelligence in interactive learning environments contributes to stimulating creativity by providing rich and dynamic educational resources.

In the same context, a study by Ritter *et al*. [20] explored how to employ generative AI in developing educational tools based on interaction and self-directed learning. The study concluded that these tools help improve the quality of learning by supplying content that adapts to students' learning styles and stimulates innovation in digital learning environments.

It is clear from the above that despite the existence of many studies that have addressed the impact of generative AI on creativity, there are research gaps related to the use of this technology in enhancing digital creativity skills among graduate students in organized academic environments. This research contributes to bridging this gap by providing a direct comparison between the production of the experimental and control groups to evaluate the impact of generative AI on the quality of digital content. First, develop a methodological framework for using generative AI platforms in the educational process and analyze their effectiveness compared to traditional methods. Then, supply insights on how to integrate generative AI into curricula to enhance creative thinking among graduate students.

Traditional methods for developing creativity skills rely on strategies such as brainstorming, face-to-face training, and workshops based on personal interaction. While these methods are sometimes effective, they can face challenges related to limited access and a lack of diversity in the ideas presented. In contrast, techniques based on generative AI provide students with greater opportunities to explore innovative ideas, interact with multiple knowledge sources, and receive immediate feedback, thereby enhancing their creativity and increasing the efficiency of the educational process. Thus, comparing the two methods highlights the urgent need to explore the feasibility of using AI as an effective alternative or complement to traditional methods.

A review of the literature reveals that several studies on the use of AI technologies to enhance digital creativity have faced methodological challenges, such as the use of small or unrepresentative research samples or the reliance on measurement tools that lack clarity and reliability. Furthermore, some studies have focused on theoretical aspects without sufficient attention to practical application and its real-world impacts. These methodological gaps and limitations reinforce the need for more methodologically rigorous applied studies, which the current research attempts to achieve by adopting a clear methodological design and accurate measurement tools.

III. Methodology

The current research used the quasi-experimental approach based on the two-group design with pre- and post-application of research tools.

A. Research Procedures

To show the effect of generative artificial intelligence technology on the development of creativity skills in the production of smart digital content among graduate students at the College of Education, King Khalid University, the following was done:

First came the selection of the research sample. The research sample was selected from graduate studies students at the College of Education, King Khalid University, Abha, Saudi Arabia. The sample was chosen in a random manner and represented by two groups: the first was an experimental group numbering 32 students who were trained through generative artificial intelligence platforms, while the second experimental group, also numbering 32 students, was trained

in the usual way at the university through the Blackboard platform available at the university.

Next, the control group was taught using traditional methods, relying on live lectures, theoretical explanations, and traditional classroom discussions. The Blackboard platform was used to manage the educational process, provide educational content, submit assignments, and conduct interactive activities without incorporating any generative AI technologies or applications. To ensure the equivalence of the two groups, the research tools were applied pre-application, and the results were as shown below in Table 1.

Table 1. Results of the t-test for digital creativity in the pre-application

The Tool	Number	The Group	Average	Standard Deviation	Degree of Freedom	T-Value	Significance Level	Significance
Digital Creativity test	32	Experimental	6.28	1.20	62	0.516	0.608	Not Significant
	32	Control	6.06	2.08				

Table 1 shows that the calculated t-value of 0.516 on the digital creativity test was not significant at the level of 0.05. This shows that there is no statistically significant difference between the two groups in the pre-application of the digital creativity test, proving the homogeneity of the two groups.

The homogeneity test, Levene's Test, was also used, and its value was 3.222, and the value of $p = 0.078$ was greater than 0.05, meaning that there is no statistically significant difference in the variance between the two groups, indicating that the variance of students' grades is close between the experimental and control groups. This means that both groups were homogeneous before applying the generative technology. Also, the successor of the graduate students specializing in educational technology is almost similar, as they specialize in educational technology, teach the Computers in Education course, and belong to a similar environment in economic and social aspects.

The research sample was characterized by a high degree of similarity in technical level among the students. All participants were graduate students majoring in educational technology, meaning they had a similar technical background. Given the nature of their academic specialization, all students possessed both basic and advanced skills in dealing with technology and digital applications, ensuring that any differences in results were not due to significant differences in basic technical knowledge but rather to the influence of the variables on which the current research focused.

From the above, it is clear that the data is normally distributed, which allows the use of parametric statistical analyses, and the variance of the two groups is homogeneous, which means that there is no problem of bias in the sample before the start of the experiment. Also, there is no statistically significant difference in the pre-average, which enhances the validity of the final results when comparing the change after applying the experiment.

Second came the preparation of the research materials that began with the designing of a learning environment based on generative artificial intelligence technology. Additionally, some earlier studies were reviewed, such as Refs. [9] and [18]. Moreover, the general Analysis Design Development Implementation Evaluation (ADDIE) design model was followed as such:

1) The first stage: Analysis

The following procedures were conducted at this stage:

- Defining the general goals of the learning environment based on generative artificial intelligence technology. The general objective of this environment is to develop creativity in the production of smart digital content in the course Computers in Education – 6000 Tech-2 in the research sample.
- Determining the characteristics of learners: Graduate students at King Khalid University's College of Education are studying the course Computers in Education – 6000 Tech-2 in the second semester of the 2023/2024 academic year and belong to one environment with similar conditions. Moreover, their skills in using computers and internet networks are almost similar, and the number of students in both the experimental group and the control group equals 32 students each for a total sample of 64 students.
- Capabilities of the educational environment: Generative artificial intelligence technology was used, including ChatGPT4 and GPT Plus.
- Educational material: The training content included 6 training units.

2) The second stage: Design stage

The design stage includes defining the procedural goals of the learning environment based on generative artificial intelligence technology and developing a comprehensive vision of the content, learning strategy, various activities appropriate for it, and evaluation methods, which are as follows:

a) Procedural goals of the learning environment based on generative artificial intelligence technology

Topic One: Designing a video with artificial intelligence (https://pixverse.ai/login).

After completing this content, the student should be able to:

- Discuss what generative artificial intelligence is.
- Design a 2D video from text.
- Design a 2D video from images.
- Use the website https://runwayml.com.
- Design a professional 3D video.

Topic Two: Designing logos and packaging for products (https://www.zarla.com)

After completing this content, the student should be able to:

- Design a creative logo.
- Design a closure for educational or commercial products.
- Design an advertisement for digital marketing.

Topic Three: Designing electronic mind maps (https://whimsical.com).

After completing this content, the student should be able to:

- Know what electronic mind maps are.
- Explain the importance of electronic mind maps.
- Design an interactive electronic mind map.

- Publish an electronic mind map.

Topic 4: Website Design: https://durable.co.

After completing this content, the student should be able to:

- Know what website design is and use the website https://durable.co.
- Use ChatGPT to get codes.
- Design an interactive educational website.

Topic 5: Design a smartphone application (https://codepen.io)

After completing this lesson, the student should be able to:

- Discuss what smartphone applications use ChatGPT to get CSS codes.
- Use ChatGPT to get JavaScript codes.

Topic 6: Designing smart electronic content (https://www.tutorai.me)

After completing this lesson, the student should be able to:

- Know what smart electronic content is and design an interactive electronic unit.
- Uses the tutorai.me website.
- Designs interactive electronic activities.

B. Content of the Learning Environment

The content of the learning environment based on generative artificial intelligence technology included the following topics:

Topic 1: Designing a video using artificial intelligence.
Topic 2: Designing a logo and product covers.
Topic 3: Designing electronic mind maps.
Topic 4: Designing a website.
Topic 5: Designing a smartphone application.
Topic 6: Designing smart electronic content.

C. Learning Strategy and Activities Followed in Artificial Intelligence Platforms

In light of the procedural goals and the content of the learning environment, the learning strategy using generative artificial intelligence technology proceeded according to the electronic lecture method and implemented all practical and training activities on the computers available in the college and viewed all results.

D. Evaluation Methods

Evaluation methods varied to include pre-evaluation at the beginning of each topic to assess previous learning, formative evaluation during each content to guide student learning and provide feedback, and final evaluation, which is done after completing the study of all training content designed according to generative artificial intelligence technology to assess the development of creativity skills in creating smart digital content in the computer course in education.

E. Preparing Research Tools

This test was prepared according to the following steps:

1) The objective of the test

The aim of the test is to measure creativity skills in creating smart digital content through the use of generative artificial intelligence technology among graduate students at the College of Education, King Khalid University, in the course Computers in Education.

2) Dimensions of the test

After reviewing the research and studies that focused on the field of digital creativity, the main elements of the test were identified, and their number reached five activities. Each activity measures digital creativity skills, including digital fluency, digital flexibility, digital originality, and digital vitality.

3) Test correction method

Each skill of the test was corrected after deleting the wrong solutions and ideas according to the following:

- Digital Fluency Skill: This was measured by the number of digital ideas or designs presented by the student and is given one score.
- Digital Flexibility Skill: This was measured from the fluency skill because it is related to the diversity of digital ideas or designs presented by the student.
- Digital Originality Skill: This was measured directly from the fluency tests, after determining the originality weights, according to the frequency of the response in the research sample. Torrance used a scale ranging from zero to five degrees to determine the degree of originality according to Table 2.
- Digital Vitality Skill: This was measured by the number of digital ideas or designs that are related to a service or solving a problem in society, and the student is given one degree for any vital activity or idea.

Table 2. Deciding the degree of digital originality according to the Torrance scale

Degree	Response frequency	M
0	More than or equal to 5%	1
1	From 4% to 4.99%	2
2	From 3% to 3.99%	3
3	From 2% to 2.99%	4
4	From 1% to 1.99%	5
5	Less than 1%	6

4) Presenting the first version of the test to the arbitration group

After completing the preparation of the test, the test was presented to a group of specialists in the fields of educational technology, information technology, and psychology, and their opinions clarified the suitability of the test for the research sample, with the linguistic reformulation of the first and fourth questions.

5) Exploratory application of the test

After knowing the opinions of the arbitrators, the test was applied to a survey sample of 22 postgraduate students at the College of Education, King Khalid University, Abha, Saudi Arabia, to determine the validity of the linguistic formulation of the test and the suitability of the test activities for students, as well as to calculate the test stability.

6) Calculating test stability

After presenting the test to a group of arbitrators and testing it on 22 students, the test stability was calculated using the Pearson equation, and it was found to be approximately equal to 0.88, which is an appropriate percentage for the test stability.

7) Final image of the test

After formulating the test and presenting it to a group of arbitrators and controlling it statistically, the test became valid for final application.

8) Pre-application of research tools

The research tools represented in the smart digital content creation test were applied to the research group in the second semester of the academic year 2024.

9) Implementation of the research experiment

After clarifying the purpose of the experiment, the researchers implemented the research experiment in the second semester of the year 2024 at the College of Education for approximately six weeks. The number of members of the research group reached 32 students who were taught the course Computers in Education through the use of generative artificial intelligence technology, version 4. The participants were trained in the following skills: professional video design, logo design, cover and product design, electronic mind map design, professional website design, smartphone application design, and smart electronic content design.

10) Post-application of measurement tools

After completing the application of the research experiment, the measurement tools represented in the smart digital content creation test were applied pre- and post-application to the two research groups, corrected, and checked.

IV. Research Results and Discussion

After checking the students' grades in the post-application of the digital creativity test in the "Computers in Education" course, the research questions were answered as follows:

The first question was, "What is the effect of using generative artificial intelligence technology on developing creativity skills in creating smart digital content among graduate students?".

To answer this question, the following hypothesis was formulated: There is no statistically significant difference at the 0.05 level between the average scores of the experimental group and the control group in the post-application of the digital creativity test in the Computers in Education course among graduate students.

To test the validity of this hypothesis, statistical processing was carried out using the two independent samples to compare the scores of the application of the digital creativity test for the experimental group and the control group. Table 3 shows the results of applying the t-test to indicate the significance of the differences between the average scores of the experimental group and the control group in the digital creativity test in the Computers in Education course.

Table 3. The value of "T" and its statistical significance between the average scores of the students of the experimental and control groups on the digital creativity test

The Group	Number	Average	Standard Deviation	Degree of Freedom	Valu (T)	Significance Level	Significance
Experiment	32	78.10	1.20	62	7.02	0.001	Significant
Control	32	69.80	2.08				

Table 3 shows that the calculated t-value is 7.02, which is significant at the 0.05 level, and the significance of both sides, and the degree of freedom is 62, which indicates the existence of a statistically significant difference between the experimental and control groups in the post-application of the digital creativity test in the Computers in Education course. Thus, the first hypothesis of the research was rejected, as there is a statistically significant difference at the 0.05 level between the average scores of the experimental group and the control group in the post-application of the digital creativity test in the Computers in Education course among graduate students in favor of the experimental group that used generative artificial intelligence technology. This result is consistent with the results of the Asbar International Forum (n.d.), whose researchers believe that the earlier result can be attributed to the following:

1) Digital Flexibility Skills: This skill reflects students' ability to adapt to different digital challenges and repurpose available tools in innovative ways according to their needs. Through training in the use of generative AI, students were able to develop digital content that can be easily changed and adapted to different requirements, whether in the educational or professional field. This skill also helped them explore innovative design techniques, which enhanced their ability to analyze digital problems and find multiple solutions to them by using several platforms to create and design websites and interactive content.
2) Digital Originality Skills: Innovation and creativity are among the most important aspects that were enhanced among students in the experimental group, as the research results showed that the use of generative AI led to the production of digital content that is characterized by modernity and uniqueness compared to traditional designs. This was evident in the students' ability to present new and unconventional ideas and design digital projects that bear their creative imprint, reflecting a deep understanding of the use of AI technologies to improve the quality of digital production. This skill also helped in developing innovative and creative digital educational solutions, making them more attractive and interactive for learners.
3) Digital Vitality Skills: This skill represents the ability of students to produce digital content that achieves societal or educational goals and enhances digital interaction in different learning environments. Training in generative artificial intelligence has enabled students to design digital solutions aimed at addressing educational issues, such as designing educational websites, developing smart applications to support the educational process, and creating smart electronic content that adapts to the needs of learners. This skill also helped them realize the importance of innovation in improving the quality of digital content to be more influential and effective. Generative artificial intelligence technology enables innovative designs that are not familiar to individuals because it has a huge database of many ideas, and this has helped in creativity in digital design. Examples of digital design include designing a logo for use in university education, as well as designing an electronic map of digital platforms, as shown in the following Fig. 2.

The use of generative AI technology had a noticeable impact on developing the digital creativity skills of the experimental group students. This development was reflected

in four main axes: digital fluency, digital flexibility, digital authenticity, and digital vitality, which formed the basis for improving the quality of digital content produced by students. As for digital fluency, this skill represented the students' ability to produce many digital ideas and designs in a brief time using generative AI tools. Students were able to generate diverse digital content, such as designing creative logos, producing explanatory videos, and creating interactive mind maps. Training on generative AI also enabled them to work on several platforms specialized in designing digital content, which helped them increase digital productivity and achieve speed and accuracy in producing various digital products.

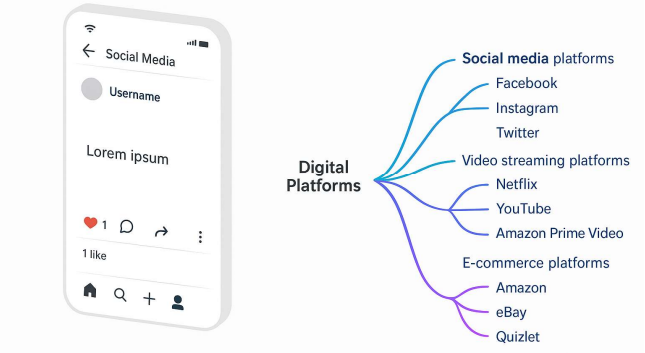

Fig. 2. Digital design of an electronic mind map and educational logo.

The results of the current study indicate a statistically significant effect of generative AI technology on enhancing creativity among graduate students in the field of smart digital content production. However, it is important to discuss the magnitude of this effect, which manifests itself in improving students' creative thinking skills using AI tools. This effect could have significant educational implications, as this technology contributes to the development of innovative teaching methods that contribute to enhancing students' ability to think critically and creatively. This effect reflects the need to integrate AI into curricula to provide interactive learning environments that support creativity and enhance students' ability to deal with the challenges of the 21st century. Based on these results, it can be concluded that the integration of AI technology into education is not limited to improving academic proficiency but extends to developing the professional skills students need in fields such as digital marketing and design, reflecting broad educational dimensions that include changing educational policies to be more compatible with the requirements of the digital age.

The results of this research indicate that the use of generative AI applications contributes significantly to developing digital creativity skills among graduate students. This is consistent with previous studies, such as Ref. [14], which confirmed that generative AI applications enhance critical and creative thinking skills by proposing new ideas and motivating students to analyze possible alternatives. These results are also consistent with Ref. [2], Which showed that generative AI applications support problem-based learning, which contributes to the development of students' analytical and creative skills. Despite this consensus, the current results pose a challenge to some traditional concepts about digital creativity, which assumed that creativity is primarily associated with independent human thinking without technological intervention. While some previous studies, such as Ref. [20], indicated that educational technologies may contribute to facilitating learning but cannot replace human creative thinking, this study shows that generative AI platforms provide an interactive environment that helps stimulate creativity by providing unconventional creative suggestions and providing diverse and rapid design options.

These findings also challenge some of the concerns raised by Ahmed [17] that the use of AI applications could lead to a decrease in students' reliance on critical thinking. The results of the current study showed that students who used generative AI applications produced more diverse and creative ideas compared to the group that relied on traditional methods. Additionally, the current findings support the findings of Ref. [3], which demonstrated that generative AI can be an effective tool to support digital designers by providing innovative design solutions and reducing the time and effort required to produce creative content. This study also confirms that these applications are not merely supportive applications but can be considered training platforms that help students develop digital design skills more effectively.

Based on these results, developing these four skills not only improved students' production of digital content but also enabled them to use generative AI effectively, making them more prepared to deal with modern technological developments in the fields of digital design and creative content production. Based on the above, the current research adds a new dimension to the discussion about the role of AI in education and digital creativity, as it indicates that integrating these technologies into curricula can significantly enhance the quality of students' creative outputs and open new horizons for developing educational models based on human-machine interaction.

Through Table 4, the researchers explain the practical or applied significance of the research results by finding the size of the effect of the independent variable on the dependent variables.

Table 4. Scientific and applied significance of the research results

Independent Variable	Dependent Variable	Valu(T)	Eta Square η^2	Effect Size
Experiment Control	Creativity in digital content design	7.02	0.44	Big

Table 4 shows that the size of the impact of generative artificial intelligence technology on developing creativity skills in designing digital content among graduate students at the College of Education, King Khalid University, is 0.44, which is a large percentage, and the rest is due to various other factors, including the student's experience and previous technological skills, the students' environment, peers, and other factors.

The results showed a statistically significant effect of using generative AI on the development of digital creativity among graduate students, with an eta square (η^2) value of 0.44, showing a large effect according to the impact size measurement criteria. This writes down that the use of generative AI explains a significant proportion of the

variance in the development of digital creativity compared to traditional methods.

From a pedagogical perspective, these results reflect the importance of integrating generative AI into educational curricula, as it contributes to enhancing creative thinking and producing digital content in a more interactive and innovative manner. Adopting this technology may also help develop modern teaching strategies that focus on exploration and independent learning, thus better preparing students for the demands of the accelerating digital labor market.

V. Conclusion

In response to the rapid development of artificial intelligence, this study highlights the value of integrating generative AI into educational settings to enhance students' creative and digital skills. The research findings demonstrate that students trained to use generative AI platforms showed measurable improvement in areas such as originality, digital fluency, flexibility, and creative problem-solving. These results suggest that generative AI can serve as more than just a technical tool—it can become an effective educational partner that transforms learning into a more dynamic, interactive, and personalized experience. Moreover, AI's ability to tailor content based on individual learning patterns offers new opportunities for inclusive and adaptive education. However, the integration of such technologies is not without challenges. It necessitates equipping both educators and learners with the skills to use AI effectively, while also promoting ethical awareness about its use. Importantly, the role of human creativity must remain central, with AI serving as a support rather than a substitute. Ultimately, this research calls for a strategic investment in generative AI as a means of fostering innovation in education and preparing students to meet the demands of a rapidly evolving digital world.

Based on the results of the current research, the following can be recommended:

1) Integrating generative AI into curricula in an organized and thoughtful manner so that students are taught how to benefit from these technologies to enhance their creative abilities in producing digital content.
2) Designing training programs for teachers and students on how to use generative AI tools in an effective manner, with a focus on developing digital and creative skills.
3) Developing smart learning environments based on generative AI so that it is used to create interactive and dynamic courses that respond to learners' needs and help them develop critical and creative thinking skills.
4) Conducting further studies on the impact of generative AI on various educational aspects, such as stimulating innovation, developing adaptive learning strategies, and enhancing critical thinking skills.

In light of the research results, some of the following research can be suggested:

1) Designing a training environment based on generative artificial intelligence technology to develop information processing skills among university students.
2) Designing an e-learning environment based on generative artificial intelligence technology to develop digital intelligence skills and future foresight among university students.
3) A proposed training program based on generative artificial intelligence technology to develop the skills of designing pioneering digital products among university students.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

ASA led the conceptualization of the study, designed the research methodology, supervised the entire project, and wrote the initial draft of the manuscript; AYA was responsible for the technical implementation, including data curation, platform integration, and statistical analysis, and contributed significantly to reviewing and refining the manuscript; AMI managed the practical aspects of the study, such as coordinating training sessions, overseeing participant engagement, and supporting project administration and review; AAT conducted the literature review, contributed to the theoretical framework, participated in data interpretation, and assisted in the final editing and proofreading process; all authors had approved the final version.

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