PAPER

Interactive Digital Platforms and Artificial Intelligence Applications to Develop Technological Innovation Skills Among Saudi University Students

Ahmed Sadek Abdelmagid[1](✉),
Mohamed Ahmed Hafez[2],
Eman Wefky Ahmed[3], Naif
Mohammed Jabli[2], Asem
Mohammed Ibrahim[4],
Ahmed Ali Teleb[5], Nader
Mohammad Aljawarneh[6]

[1]Educational Technology,
College of Education, King
Khalid University, Abha,
Saudi Arabia

[2]Faculty of Engineering and
Quantity Surveying, University
in Malaysia, Nilai, Malaysia

[3]Department of Curricula and
Teaching Methods, Faculty of
Education, Sohag University,
Sohag, Egypt

[4]Curriculum and Teaching
Methods, College of
Education, King Khalid
University, Abha, Saudi Arabia

[5]Psychology, College of
Education, King Khalid
University, Abha, Saudi Arabia

[6]Department of Business,
School of Business, Jadara
University, Irbid, Jordan

abdelmagid@kku.edu.sa

ABSTRACT

In this paper, we investigate the efficacy of an edX-based learning technology and learning environment augmented with artificial intelligence (AI) applications in fostering technological innovation skills among university students. A quasi-experimental design was employed, involving two groups of bachelor's degree students (n = 57) from the College of Education at King Khalid University. The experimental group (n = 28) utilized the edX platform with integrated AI features, while the control group (n = 29) employed the traditional Blackboard platform. Both groups participated in the "Using Computers in Education" course. A pre-post assessment of technological innovation skills was conducted, and the data were analyzed using an independent sample t-test. Results revealed a statistically significant difference in skill development between the groups, favoring the edX platform with AI integration. These findings suggest that using blended learning environments may have the potential to enhance students' technological innovation capabilities.

KEYWORDS

learning technology, electronic platforms, artificial intelligence (AI), technological innovation

1 INTRODUCTION

Due to the significant advancements in the field of the Internet, the concept of massive open online courses (MOOCs) became widespread. George Siemens was the first to coin this term for learners during the course "Connectivism and Connective Knowledge" at the University of Manitoba in 2008. The idea behind these courses is rooted in the philosophy of the Open University and technological platforms. However, the MOOC did not officially start until 2012. When Stanford University launched the first MOOCs in the "Introduction to Artificial Intelligence (AI)" course, it attracted more than 160000 subscribers from all over the world [14].

E-learning platforms are defined as a set of educational services available via the Internet that integrate social networks and e-learning management systems. They provide teachers, learners, parents, and educational participants with information, interactive tools, and resources to support and enhance educational content for learners through a comprehensive web-based system that utilizes a secure and user-friendly interface [15].

Many universities around the world have utilized learning management systems such as Blackboard, Moodle, and other similar platforms for university education. These systems are very limited and cannot perform all the functions and operations that traditional systems can. They also lack the interactions that take place between teachers and learners, as well as among learners themselves, including information sharing, lecture presentations, abstracts, working papers, and more. Since this information is essential and required, students resort to accessing it outside of learning management systems; these platforms are known as traditional e-learning management systems. They are traditional in form and subject matter, and they succeeded in managing the learning process, but they did not succeed in learning itself [12].

As a result, electronic educational platforms have emerged as a new model of digital companies that connect individuals using technology. Through these platforms, a community learning environment can be created based on creating and exchanging value by hosting multiple categories of users who can be consumers and producers simultaneously, similar to "Amazon," or a unique type of user who interacts within a social framework, akin to "Facebook." All types of platforms share the common ability to bring people and organizations together in one place so that they can interact within it. The more users on the platform, the greater the number of interactions that occur within it, leading to a growing impact on the network [6].

The emergence of open educational courses has led to the development of numerous educational electronic platforms that stand out for providing educational content in a professional and interactive manner. The most prominent platforms include Coursera, EdX, Udacity, and others. The Arab world was not far from these initiatives. Arab initiatives have emerged to launch open educational courses, the most famous of which are the Rwaq and Edraak platforms. However, these Arab initiatives differ from their foreign counterparts in that they were not launched by universities but rather were initiatives of individuals or institutions [8], [5].

[16] points out that e-learning platforms are based on the foundations and principles of social constructivism theory. They contribute to helping the learner obtain, generate, or produce the content. They may be built, modified, or adapted by the teacher or learner to support online participation, discussion, and engagement.

Among the most prominent Arab initiatives in this field is the ALECSO initiative, which officially launched an Arab platform for open educational courses.

This network is a popular Arab platform accessible on the Internet. Its aim is to collect open digital Arabic educational resources and share them with teachers, learners, and individuals interested in all Arab countries and worldwide [11].

The global reliance on e-learning platforms in the field of education, especially in light of crises such as the spread of the COVID-19 coronavirus, has led to a significant change in the teaching and learning processes. AI and its applications have become one of the methods that can help in understanding what the learner is doing and what they are unable to do [13]. AI applications can design adaptive electronic content and present it to learners in an intelligent manner, tailored to their abilities and requirements. AI applications help to assess the capabilities of each learner and provide assistance and clarification for any part that is not understood. Hence, AI applications can help develop the various abilities of learners with high efficiency.

There are numerous applications that depend on AI systems in the field of education. These applications are used to monitor and extract educational data to track student behavior and provide support to students who are at risk of dropping out of their studies. When analyzing a learner's response to multiple-choice questions in mathematics, teachers typically consider the learner's score and grades. In contrast, AI applications can delve deeper to gain insights into the actual challenges encountered by the learner. AI tools can ascertain whether the student struggles with the fundamental concept or if the confusion arises from the question itself. Essentially, AI applications can pinpoint the specific step that the student overlooked and provide guidance on the correct approach [19].

In this aspect, the study by [9] concluded that chatbots are among the modern applications of AI that can be used to provide educational content to students in a fun and engaging manner. This is achieved by breaking down a single lecture into a series of interactive questions and incorporating texts, images, videos, and comments. This approach differs from presenting all the content at once, allowing for adaptive learning tailored to each student's individual needs and schedule. Given the significance of AI applications in the education sector, the study suggests integrating these applications into teacher training programs to align with the evolving demands of the job market.

A study found the effectiveness of interactive chatbots in developing educational research skills among postgraduate students [1]. Therefore, [6] indicates that the platform revolution is a trend for entrepreneurs and innovation based on platforms that have achieved pioneering successes, such as Facebook, Uber, YouTube, and other successful platforms. Therefore, the book "*The Platform Era*" confirms the inevitability of platforms in the future. It suggests that the next revolution will lead to significant advancements in the fields of education and the economy.

The fourth industrial revolution and AI, along with their various applications, will have a significant impact on the future labor market. Some jobs will disappear, and some new jobs will appear. This requires anticipating the future and preparing for it through knowledge, experience, and continuous discussions. The scientific journal will soon update the language used in its announcements. Instead of being the holder of a specific certificate with a certain number of years of experience, the qualifications will now be based on a list of skills that will be assessed. If he possesses the necessary skills, he will be accepted for this job, regardless of the certificate he holds. Therefore, universities will find themselves facing more challenges in developing the educational process to ensure that a university degree holds real value. University institutions should also pay attention to updating educational content in line with AI applications and labor market requirements [14].

[7] It is pointed out that the stereotype in universities is that innovation is taught, not practiced. The majority of learners typically confine themselves to "normal science," where their thoughts are bound by established definitions, knowledge, and information. They often lack the inclination to foster innovation and generate new ideas through engagement.

2   RESEARCH PROBLEM

Graduates of Arab universities face challenges when trying to integrate into the labor market. The study concluded that the current labor market, as well as its future prospects, do not align with the skills and qualifications of graduates from higher education institutions. This is due to the incompatibility of the outputs of

these institutions, both in terms of quantity and quality, with the demands of the labor market. Where universities are interested in imparting extensive knowledge and information, they often neglect the skills necessary for fostering innovation [2]. The number of individuals with technological innovation skills in Arab higher education institutions is limited. Arab university institutions are still unable to cultivate new generations of technological innovators who spearhead the development process in Arab national economies [10]. [17] confirms this, as university education institutions do not provide the necessary flexibility to nurture talent, creativity, and innovation. They also have a significant shortcoming in providing a creative learning environment for students, and the traditional educational style is one of the most important obstacles to creativity and innovation. In this regard [18] indicates that Arab universities are not very interested in the field of technological innovation. Instead, they focus on exam performance knowledge or the culture of memorization rather than fostering creativity and innovation. [20] It is noted that the history of technology universities can be summarized as a focus on acquisition, where the main strategy of educational institutions is "buy and keep buying," leading to superficial technological use. This is because most technological products simply transform traditional content into digital formats. As a result, learners believe that they are engaged in important technological learning and that they have the ability to create and innovate, but in fact, they know very little.

[4] It is indicated that there are many obstacles to technological innovation, most notably the educational institution's lack of interest in research-based and participatory strategies, which discourages technological innovation, in addition to the lack of interest in modern and exciting emerging technologies that open a wide field for technological innovation, such as AI, robotics, big data analysis, the Internet of Things, and others. The participation, interaction, and integration of students in the educational process and modern technological applications are necessary conditions for the success of the educational institution, especially in light of the tremendous technological development in this era. When it comes to negativity, lack of participation and integration in the learning environment, and contentment with simply browsing websites, listening to lectures, taking notes, and saving them for the final exam, this undermines and stifles creativity and innovation among university students in the era of the Fourth Industrial Revolution.

From the above, the problem of the current study was identified as "weak technological innovation skills among university students." Therefore, the current research aims to address this weakness by integrating the global "edX" platform with AI applications to enhance their technological innovation skills.

Research question: The current study attempts to answer the following question:

1. What is the effect of integrating the electronic edX platform with AI applications on developing technological innovation skills among students at the College of Education, King Khalid University?

Research hypothesis: The current research aims to verify the validity of the following hypothesis:

H1: There is no statistically significant difference at the 0.05 level between the mean scores of the first experimental group (which used the edX platform) and the other experimental group that used the Blackboard platform in the post-application of the technological innovation skills test.

Research objective: The current research aims to enhance technological innovation skills among students at the College of Education, King Khalid University, by integrating the global edX platform with various AI applications.

Research significance:

1. Directing the attention of university education officials to the importance of incorporating electronic platforms in university education.
2. Directing university education officials' attention to the importance of incorporating AI applications in the field of university education.
3. Directing the attention of university education officials to the need to focus on developing students' skills in the field of technological innovation.
4. Directing the attention of university administrators to the necessity of establishing educational partnerships between universities and global educational electronic platforms in the field of education, such as edX, Coursera, Udacity, and FutureLearn.
5. Directing the attention of educational platform administrators to the importance of ensuring the security of students' educational information.

Research determinants: The current study is limited to the following determinants:

1. Bachelor's degree students at the College of Education, King Khalid University.
2. Artificial intelligence applications: chatbots and Otter Voice Notes.
3. The course "Using Computers in Education: 424 TRB-2."
4. The following technological innovation skills are needed: technological fluency, technological flexibility, technological originality, and technological agility.

Definitions of research terms

Electronic platforms. It is a participatory online learning environment where AI applications can be utilized in the "Using Computers in Education" course for students at the College of Education, King Khalid University. This integration aims to assist students in enhancing their technological innovation skills [21].

Artificial intelligence applications. These programs are provided and integrated with the edX platform to assist students at the College of Education, King Khalid University, in navigating their "Using Computers in Education" course. The aim is to support students in exploring the field of computers and fostering innovation.

Technological innovation. It is the ability of students at the College of Education, King Khalid University, to present new ideas, works, or technological projects individually or collectively in the field of computers and their applications. This ability is characterized by fluency, flexibility, originality, and technological dynamism for social benefit. It is measured by the score the student achieves on the test designed for that purpose.

3   RESEARCH METHODOLOGY

The current study utilized a quasi-experimental approach based on a design involving two groups with pre- and post-application of performance measures.

Research procedures. To investigate the impact of integrating the edX platform with AI applications on enhancing technological innovation skills among students at the College of Education, King Khalid University, the following procedures were implemented:

First: Selection of the research sample: The research sample was randomly selected from the bachelor's students at the College of Education, King Khalid University. The sample consisted of two groups: The first empirical group, comprising 29 students, was trained through the edX platform using free accounts (https://www.edunext.co). The second empirical group, consisting of 28 students, was trained using the university's learning management system, Blackboard. To ensure the equality of the two groups, research tools were applied beforehand, and the findings are presented in Table 1.

Table 1. Findings of the "T" test in the pre-application of technological innovation test

Tool	Group	Mean	SD	Degree of Freedom	Calculated T Value	Significance Level	Significance
Technological innovation test	1st empirical group	9.24	2.17	55	0.542	0.989	Not significant
	2nd empirical group	8.93	2.19				

Table 1 presents the calculated T-value of 0.542 for the technological innovation skills test, which is not significant at the 0.05 significance level. The test is two-tailed with 55 degrees of freedom. This indicates that there are no statistically significant differences between the two groups in the pre-application of the technological innovation skills test, suggesting equivalence between the two groups.

Second: Preparing research materials

1. **Designing a learning environment based on the integration of edX platform and artificial intelligence applications**

   To design a learning environment based on the integration of the electronic edX platform with AI applications, some previous studies were reviewed, such as the studies by [23] and [3], and the general ADDIE design model was utilized.

   First stage: Analysis: At this stage, the following procedures were performed:
   - Determining the general objectives of the learning environment involves integrating the electronic edX platform with AI applications. The primary goal of this environment is to enhance technological innovation skills in the "Using Computers in Education" course for the students in the research sample.
   - Determining the characteristics of learners: Seventh-level Bachelor's Degree students at the College of Education, King Khalid University, are studying the course "Using Computers in Education 424 TRB-2" in the first semester of the academic year 2021 AD. They belong to the same environment with similar circumstances, and their skills in using computers and Internet networks are almost identical. The number of students in the first empirical group was 29, and the number of students in the second empirical group was 28.
   - Educational material: The training content has been organized into five training units.

   Second stage: Design: The design stage includes defining procedural goals for the existing learning environment, integrating the edX platform with AI applications, establishing a comprehensive conception of the content, the learning strategy, and the various activities appropriate to it, and determining evaluation methods.

A) **The procedural objectives of the learning environment based on the integration of the edX platform with artificial intelligence applications are:**

    First topic is electronic platforms: After completing this content, the student should be able to:

- The text prompts a discussion on the nature of electronic platforms.
- Technological innovations are characterized by their ability to introduce new ideas, products, or processes that improve efficiency, effectiveness, or convenience in various fields. These innovations often involve the use of advanced technology, creative thinking, and problem-solving skills to address existing challenges or meet emerging needs. Additionally, technological innovations are typically driven by a desire to enhance performance, reduce costs, increase productivity, or create new opportunities for growth and development.
- Review the most important emerging technologies.
- Discuss the role of emerging technologies in the development of education.

    Second topic is designing interactive electronic content: After completing this content, the student should be able to:

- Understand the digital content.
- Define the elements of electronic content.
- Utilize electronic content-authoring tools.
- Design electronic content according to SCORM standards.

    Third topic is designing educational websites: After completing this content, the student should be able to:

- Understand what the educational website is.
- Define web design specifications.
- Familiarity with the Drupal system for web design.
- Design an educational website.

    Fourth topic is electronic walls: After completing this content, the student should be able to:

- Learn about electronic barriers.
- Electronic walls play a crucial role in education by providing a platform for interactive learning and access to a wide range of educational resources.
- Design an electronic wall.
- Able to publish on the electronic wall.

    Fifth topic is about word clouds: After completing this content, the student should be able to:

- A word cloud is a visual representation of text data, where the importance of each word is depicted by its size in the cloud.
- Conclude the significance of word clouds in education.
- Design a word cloud in your field of specialization.
- Utilize a word cloud in the opinion poll.

    The chatbot application was designed using the ChatFuel platform. This platform does not require programming experience; automated chat can be easily designed without any programming background. The Otter Voice Notes application has also been integrated into the edX electronic platform website (http://otter.ai).

B) **The learning environment content is:** The learning environment of the edX platform with AI applications included the following topics:

- The first topic is emerging platforms and technologies.
- The second topic is electronic content design.
- The third topic is designing educational websites.
- The fourth topic is electronic walls.
- The fifth topic is about word clouds.

C) **The learning strategy and activities used in the edX platform and artificial intelligence applications are:** Considering the procedural objectives and the content of the learning environment, the learning strategy was implemented using the edX platform, following the flowchart below (See Figure 1):
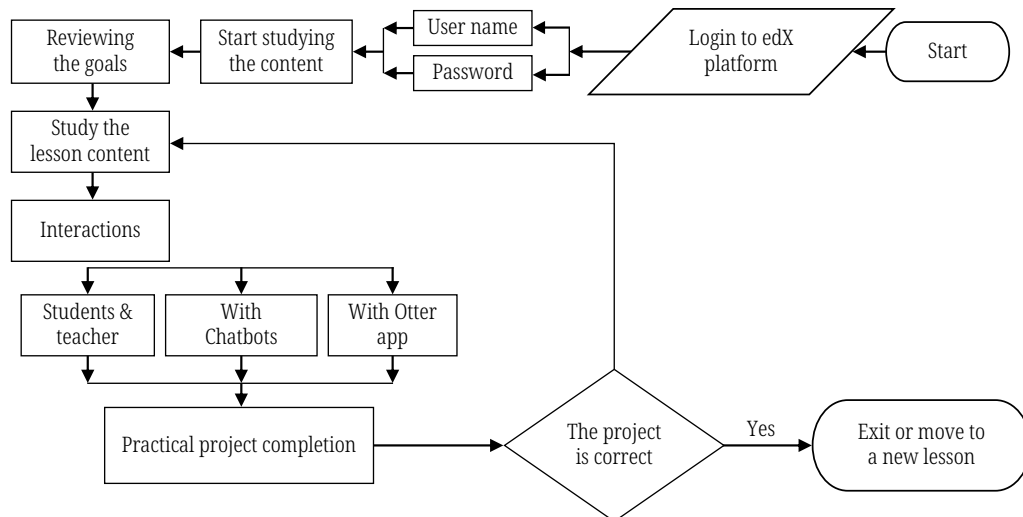

Fig. 1. Flowchart of learning strategy through edX electronic platform

Learning strategy via the e-learning management system (Blackboard): Considering the procedural objectives and the content of the learning environment, the learning strategy was implemented through the learning management system "Blackboard," following the flowchart depicted in Figure 2.
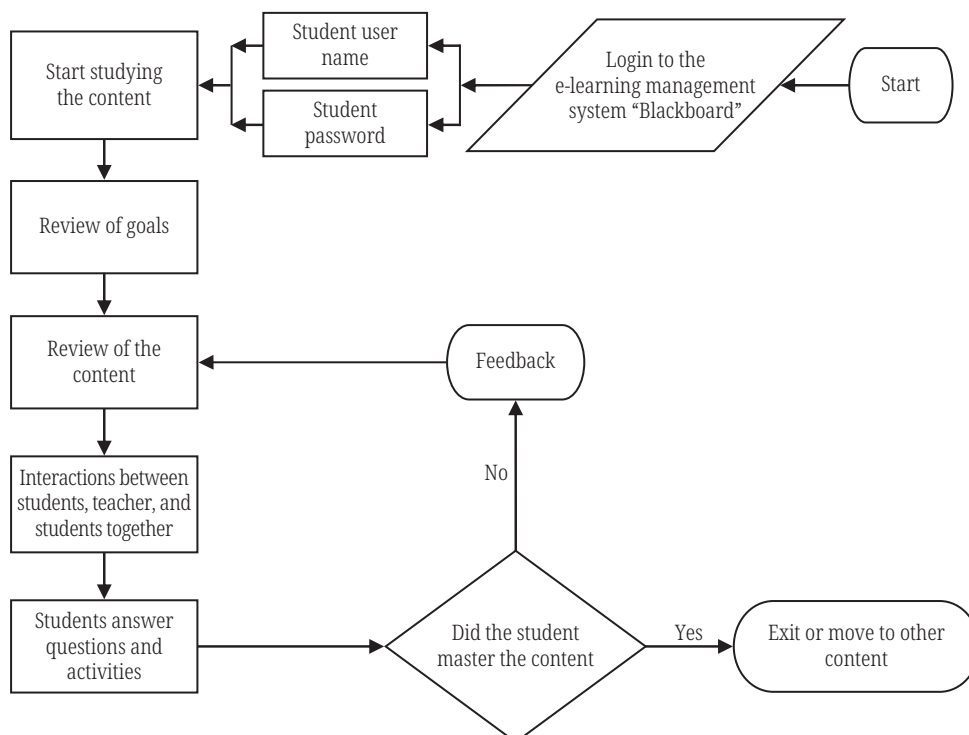

Fig. 2. Flowchart of the learning management system "Blackboard" strategy

Assessment methods. The assessment methods varied. They included using the tribal calendar at the beginning of each topic to assess previous learning, conducting formative assessments during each content session to guide student learning and provide feedback, and administering a final assessment after completing the study of all training content. The final assessment was designed based on the integration of the electronic edX platform with AI applications to identify technological innovation skills in learning and the digital trust of the research sample.

Third stage is development: At this stage, the researchers utilized several programs and applications, with the most crucial ones being as follows:

Blackboard system
VideoScribe software
https://www.edX.org platform
Visit the website: https://answergarden.ch.
Articulate Storyline Program
https://ar.padlet.com
Chatbot application
Otter Voice Notes application

Fourth stage is implementation: At this stage, the electronic content was published on the edX platform as a trial version, and it is available to 50 users. It also explained how to access the platform and the tasks that need to be completed.

Fifth stage is evaluation: At this stage, the content of the edX electronic platform with AI applications was presented to a group of specialists in the field of curriculum and educational technologies. In addition, the measurement tools represented in the Technological Innovation Skills Test were applied after studying all the training content of the students in the research sample.

Third: Preparing performance measures

Preparing for the technological innovation test: This test was prepared according to the following steps:

The purpose of the test: The objective of the test is to measure technological innovation skills for bachelor's students at the College of Education at King Khalid University in the course "Using Computers in Education."

Dimensions of the test: After reviewing the research and studies concerned with the field of technological innovation, the main elements of the test were identified, and they numbered five activities. Each activity measures the skills of technological innovation: technological fluency, flexibility, originality, and agility. The test has been framed as an activity so that the term 'test' does not cause anxiety in the students.

Test correction method: Each test skill was corrected by deleting the incorrect solutions and ideas according to the following criteria:

– Technological fluency skill is measured by the number of solutions or ideas presented by the student, and one degree is awarded to the individual.
– Technological flexibility skill: It is measured by the fluency skill as it pertains to the variety of solutions or ideas generated by the student.
– The technological originality skill is measured directly from the fluency tests after determining the weights of originality based on the frequency of the response occurrence in the research sample. Torrance used a scale from zero to five degrees to determine the level of authenticity, as shown in Table 2.
– Technological agility is measured by the number of solutions or ideas related to community service. The student is given one mark for each activity or key idea.

Table 2. Determination of the originality score according to Torrance scale

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

Presenting the initial form of the scale to a group of arbitrators: Following the development of the scale's terminology, it was introduced to a panel of experts in curriculum, educational methods, and psychology. Their opinions explained the appropriateness of the test for the study sample, with linguistic reformulation of activities (2) and (3).

Exploratory application of the scale: After receiving feedback from the arbitrators, the test was administered to an exploratory sample of 22 Bachelor's Degree students at the College of Education, King Khalid University, to assess the suitability of the linguistic formulation of the test, the relevance of the test activities for students, and to calculate the test's reliability.

Calculating the reliability of the test: After presenting the scale to a group of arbitrators and conducting exploratory testing on 22 participants, test reliability was calculated using the Pearson coefficient. It was found to be approximately 0.87, indicating an appropriate reliability coefficient for the test.

The final form of the test: After formulating the scale and adjusting it statistically, the scale becomes valid for the final application.

Fifth: pre-application of measurement tools: The technological innovation skills test was administered to the two research groups in the first semester of 2020-2021.

Sixth: implementation of the research experiment: After clarifying the purpose of the experiment, the study was conducted at the College of Education during the first semester of 2020-2021. The first experimental group consisted of 29 students, while the second experimental group had 28 students, and the experiment lasted approximately six weeks.

4   RESEARCH FINDINGS AND THEIR INTERPRETATION

After monitoring the scores of the students in the post-application technological innovation skills test in the course "Using Computers in Education," the research questions were answered as follows:

There is no statistically significant difference at the 0.05 level between the mean scores of the first empirical group (which used the edX platform) and the other empirical group that used the Blackboard platform in the post-application of the technological innovation skills test.

To test the validity of this hypothesis, a statistical analysis was conducted using the t-test for two independent samples to compare the scores of the technological innovation skills test between the first and second empirical groups. Table 3 presents the results of applying a "T" test to demonstrate the variances between the average scores of the initial and subsequent empirical groups in the technological innovation skills assessment within the "Using Computers in Education" course.

Table 3. The T value and its statistical significance between the mean scores of the students of the first and the other empirical groups in the technological innovation skills test

Group	Tool	N	M	A	Degree of Freedom	T Value	Significance
1st Group	technological innovation skills test	29	48.83	3.65	55	6.713*	Significant
2nd Group		28	40.61	5.45		6.713*	Significant

Note: A function (*) is placed at the level (0.05).

Table 3 shows that the calculated t-value is 6.713, which is significant at the 0.05 level for a two-tailed test with 55 degrees of freedom. This indicates the presence of statistically significant differences between the first and second empirical groups in the post-application of the technological innovation skills test in the course "Using Computers in Education," in favor of the first empirical group.

Thus, the second hypothesis of the research was rejected. There were no statistically significant differences at the 0.05 level between the mean scores of the first empirical group (which used the edX platform) and the other empirical group that used the Blackboard platform in the post-application of technological innovation skills test. The results favored the first empirical group, as shown in Figure 3.
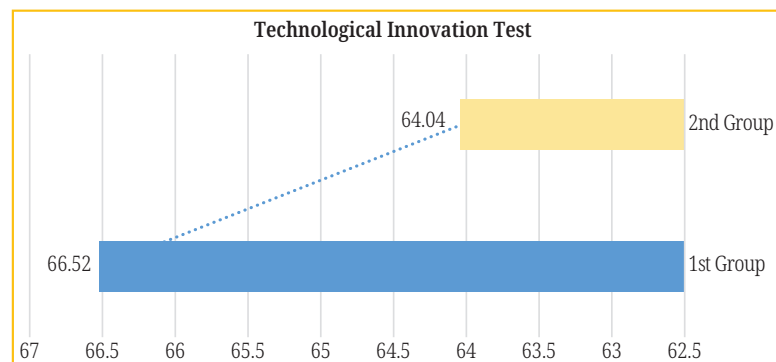
Fig. 3. Arithmetic means of the first and second empirical groups in the technological innovation test

The researchers believe that the previous finding could be due to the following:

1. The main feature of e-learning platforms in general and the edX platform in particular is "networking" in the sense of exchanging creative ideas. Through this platform, being open to others' ideas and benefiting from them by exchanging thoughts and learning new things in the field of "computers" has contributed to the development of fluency skills. Technological innovation among students in the research sample.
2. The edX platform includes tools that help students collaborate, share electronically, and exchange ideas, contributing to the development of technological innovation skills.
3. The philosophy of educational electronic platforms is based on the "communication" theory of Siemens, which places great emphasis on interaction between teachers and learners anywhere and anytime with great freedom, as well as the interaction of students with each other. This interaction and electronic brainstorming through the technological tools provided by the edX platform led to the development of their technological innovation skills.

4. The "edX" platform includes tools that help students participate in editing content and expressing opinions freely without restricting any idea or opinion.
5. The "edX" platform is characterized by students obtaining immediate feedback through the application of chatbots and developing collaborative learning skills among them. This helps students apply technology skills effectively.
6. The "edX" platform is characterized by allowing students the freedom and flexibility to perform the tasks and activities required of them.
7. Interest in AI applications and integrating them into the learning environment increased students' motivation to learn, leading to the development of innovative tendencies in the "Using Computers in Education" course.
8. The edX platform includes the Learning Management System (LMS), the Studio Platform, and an analysis tool for evaluating the performance of each participating student. This helped develop technological innovation skills and outperform the second group that used the "Blackboard" platform.
9. The integration of the edX platform with the Chatbots application has facilitated the assessment and analysis of students' various abilities, enabling the identification of weaknesses and the enhancement of strengths. Interactive chatbots have also helped diversify sources of ideas and knowledge. This led to the growth of students' intellectual fluency skills.

Through Tables 2, 3, and 4, the researchers elucidate the practical or applied significance of the research results by determining the effect size of the independent variable on the dependent variables.

Table 4. The scientific and applied significance of the research results

Independent Variable	Dependent Variable	Cohen's (d)	η^2	Effect Size
Integration between Interactive Electronic Platforms and Artificial Intelligence Applications	Technological innovation	1.81	0.45	Big

It is clear from Table 4 that the integration of the electronic edX platform with AI applications has a significant effect on the development of technological innovation skills, with a magnitude of 0.45, representing a substantial percentage.

5 DISCUSSING THE RESEARCH FINDINGS

The aim of the current study is to enhance technological innovation skills and foster digital trust among students in the College of Education at King Khalid University. This will be achieved by creating a learning environment that integrates the electronic platform edX with various AI applications.

First, what is the effect of the integration between the electronic edX platform and AI applications on the development of technological innovation skills in learning among students of the College of Education King Khalid University?

The findings showed that the students in the first empirical group who used the edX platform had significantly higher abilities in developing technological innovation skills in learning compared to the students in the second group who used the "Blackboard platform." This indicates that the students in the first empirical group

derived greater benefits from the edX platform and AI applications compared to the students who were trained using the "Blackboard" platform.

This may be due to the main idea of utilizing platforms in general and the "edX" platform in the field of education, based on the principles of consumption, production, and innovative networking simultaneously. Each student reviews and learns the lesson presented on the platform, initially in consumer mode. However, through interaction and communication with others, they incorporate new knowledge and ideas into the content. Consequently, the student transforms into an innovative product capable of adding value to electronic content. All of this helped to develop students' technological innovation skills. The students also experienced the joy of learning through the platform and their utilization of technology, guided and directed by the teacher, at any time and from any location. This result is consistent with the findings of the study by [23] and [22].

6   RESEARCH RECOMMENDATIONS

Based on the current research findings, the following are recommended:

1. The importance of training university students in technological innovation skills through global e-learning platforms such as edX and Coursera is crucial.
2. The necessity of training faculty members to design and utilize e-learning platforms is crucial for facilitating student collaboration, sharing contemporary information, and fostering the development of innovative skills in the education sector.
3. It is essential to focus on enhancing the skills of university faculty members in utilizing AI applications in the field of education.
4. The need to pay attention to the design of courses on electronic platforms is emphasized; research promotes technological innovation.
5. The importance of focusing on the integration of AI applications into interactive electronic platforms.

Suggested research: In light of the research findings, the following researchers can be suggested:

1. A proposed training program based on e-learning platforms to develop digital entrepreneurship skills among university students.
2. Developing an e-learning environment grounded in "design thinking" to cultivate digital intelligence skills and design digital platforms among students in the College of Education.
3. A proposed unit in the field of "Artificial Intelligence Applications" aims to cultivate digital transformation skills, enhance future foresight, and foster digital intelligence among university students.

7   CONFLICT OF INTEREST

The authors declare that there are no conflicts regarding the publication of this paper.

8 ACKNOWLEDGEMENTS

9 REFERENCES

[1] Abdel Bar, Abdel Nasser, and Abdel Hamid, "A program based on interactive chatbots and Egyptian Knowledge Bank trips to develop some educational research skills and academic self-efficacy among postgraduate students at the faculty of education," *Journal of the Faculty of Education*, Benha University, vol. 31, no. 121, pp. 347–416, 2020.

[2] Othman Ahmed and Tariq Wahbi, "Graduates of educational institutions and the labor market," *MENA Journal of Economic Studies*, vol. 2, no. 1, pp. 159–182, 2018.

[3] Al Mahamadi and Ghadir Ali, "Designing an adaptive learning environment based on artificial intelligence and its effectiveness in developing the skills of digital technology applications in scientific research and future information awareness of talented female students at the secondary level," [Unpublished Ph.D. Thesis]. Umm Al Qura University, 2020.

[4] Ghada Shaker Al Shami, *Curriculum Engineering and Anticipating the Future of Technological Innovation in the Digital Age*, Al Rushd Library, 2020.

[5] Dalia Khalil Al Shawarbeh, "The degree of use of electronic educational platforms by postgraduate students in private Jordanian universities and their attitudes towards them [a published Master's Thesis, Middle East University]," 2019.

[6] Saif Al Suwaidi, *Building Digital Platforms*. Platform I want, 2020.

[7] Victor Beckers, Jurian Edelenbos, and Bram Stegen, *Innovation in the Public Sector – Linking Capability and Leadership* (Bandar bin Qasim Al Hajan, Translator). Institute of Public Administration, 2019.

[8] Taghreed Abdel-Fattah El-Rehaili, "Learning platforms with open online courses have massive enrollment in Saudi higher education institutions – Opportunities and challenges [Research]." Creative Learning in the Digital Age, Egyptian University for E-learning, 2016.

[9] Naglaa Mohammed Fares, "The use of a learning environment based on content sharing networks and its impact on achievement, reflective thinking, and cognitive absorption among educational technology students," *Educational Journal*, vol. 79, no. 1, pp. 765–809, 2020.

[10] Naglaa Mohammad Faris, Ali Hassan Abadi, and Mahmoud Mohammad Hussein, "The effectiveness of an e-learning platform based on digital participatory stories to develop collaborative organization and belonging to the homeland among South Valley University students," *Educational Journal, College of Education in Sohag*, vol. 68, no. 1, pp. 505–605, 2019.

[11] Mohamed Nasser Ibrahim and Aisha Belheish Al Omari, "Open educational resources unlimited options," *Obeikan Library*, 2021.

[12] Mohamed Attia Khamis, *E-Learning Environments*, Academic Center for Publishing and Distribution, 2018.

[13] S. Manikanthan, T. Padmapriya, A. Hussain, and E. Thamizharasi, "Artificial intelligence techniques for enhancing smartphone application development on mobile computing," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 14, no. 17, pp. 4–19, 2020. https://doi.org/10.3991/ijim.v14i17.16569

[14] Mohamed Attia Khamis, *Recent Trends in Educational Technology and Areas of Research.* Academic Center for Publishing and Distribution, 2020.

[15] T. Kiryakova-Dineva, M. Levunlieva, and V. Kyurova, "Iphras as an e-learning platform for idiomatic competence," *The Electronic Journal of e-Learning,* vol. 15, no. 2, pp. 137–143, 2017.

[16] Harazem Linda, *Learning Theories and Their Applications in E-Learning* (Saleh Mohammad Al Atiwi, translator). King Saud University House, 2020.

[17] Nevin Hussein Mohamed, *The Role of Continuous Innovation and Creativity in Ensuring the Competitive Position of Economic Institutions and Countries – A Case Study of the UAE.* UAE: Ministry of Economy, 2016.

[18] Asmaa Al Sayed Mohammad and Karima Mahmoud Mohammad, *Artificial Intelligence Applications and the Future of Education Technology.* Arab Publishing Group, 2020.

[19] Mousa, Abdullah, Bilal, and Ahmed Habib, *Artificial Intelligence is a Revolution in the Technologies of the Age.* The Arab Group for Training and Publishing, 2019.

[20] Hani Abdel Qader Othman, "The effect of teaching a proposed unit based on mathematical links in developing critical thinking skills and estimating the scientific value of mathematics among eleventh grade students in the governorates of Gaza," [unpublished master's Thesis]. Al Azhar University, 2012.

[21] R. Nurmalasari, Marsono, and A. K. Mahamad, "The role of Machine Element Applications (MEA) as interactive mobile learning to support the implementation of distance learning in machine element course," *International Journal of Interactive Mobile Technologies (iJIM),* vol. 16, no. 5, pp. 216–223, 2022. https://doi.org/10.3991/ijim.v16i05.28997

[22] S. Rakic, N. Tasic, U. Marjanovic, S. Softic, E. Lüftenegger, and I. Turcin, "Student performance on an e-Learning platform: Mixed method approach," *International Journal of Emerging Technologies in Learning,* vol. 15, no. 2, pp. 187–204, 2020. https://doi.org/10.3991/ijet.v15i02.11646

[23] J. Tan and N. Sockalingam, "Gamification to engage students in higher education," Research Collection Lee Kong Chian School of Business, pp. 1–14, 2015. https://ink.library.smu.edu.sg/lkcsb_research/4740

10 AUTHORS

Dr. Ahmed Sadek Abdelmagid is a Professor of educational technology at the Faculty of Education in Sohag. He earned master's degree in 1999 and completed his doctorate in 2003. He currently works as a professor of educational technology at the College of Education, King Khalid University since 2006. He is also an advisor to the Deanship of E-Learning and the managing editor of the King Khalid University Journal of Educational Sciences. His research interests include the design of electronic platforms, smartphone applications, generative artificial intelligence applications, and big data analysis (E-mail: abdelmagid@kku.edu.sa).

Dr. Mohamed Ahmed Hafez, Associate Professor in Civil Engineering, holds a B.Sc. from Alexandria University, Egypt, and a M.Sc. He holds a Ph.D. from the University in Malaysia, Malaysia. He specializes in coastal engineering, dam safety, and ground improvement techniques. He has authored numerous publications and received prestigious awards for his contributions (E-mail: mohdahmed.hafez@newinti.edu.my).

Dr. Eman Wefky Ahmed is an Associate Professor at Sohag University, obtained her Bachelor of Science and Education degree in 1992, and later completed her a Master's in Education in 1999. In 2004, she completed her doctorate in Curriculum and Teaching Methods at Flensburg University, Germany. Her career spans

teaching, research, and educational development, both locally and internationally (E-mail: e_wefky@yahoo.com).

Dr. Naif Mohammed Jabli is an Associate Professor of educational technology at King Khalid University. He earned a master's degree in 1438 and a doctorate in 1439 from Northern Illinois University. He currently works as an associate professor of educational technology at the College of Education, King Khalid University. He is the former Dean of the E-Learning Deanship at King Khalid University. His research interests include the design of electronic platforms, smartphone applications, generative artificial intelligence applications, and mobile learning (E-mail: njabli@kku.edu.sa).

Dr. Asem Mohammed Ibrahim is a faculty member in the Curriculum and Teaching Methods department at the College of Education, King Khalid University in Saudi Arabia. With expertise in education, Dr. Ibrahim contributes to shaping effective teaching strategies and curriculum development (E-mail: amibrahim@kku.edu.sa).

Dr. Ahmed Ali Teleb is a Professor of Psychology at the Faculty of Education, New Valley University. He obtained a master's degree in psychology from Assiut University in 2003. He obtained a PhD in Psychology in 2010 through a joint program between Konstanz University (Germany) and Assiut University (Egypt). He currently works as a professor of Psychology at the College of Education, King Khalid University, since 2011. He serves as an arbitrator for various scientific journals, including *Current Research in Psychology, Frontiers in Psychology, King Khalid Educational Journal, Sohag Educational Journal,* and others. His research interests include designing and applying behavioral, cognitive, cognitive-behavioral, emotional schemas, cognitive schema, and dialectical-behavioral counseling programs (E-mail: mmahmod@kku.edu.sa).

Dr. Nader Mohammad Aljawarneh is an Associate Professor at Jadara University in Jordan. He specializes in information technology and has made significant contributions to the field through research and teaching. With expertise in various aspects of IT, he is dedicated to advancing knowledge and fostering innovation in the academic community (E-mail: n.jawarneh@jadara.edu.jo).