Innovation in the educational process through the utilization of high technology to build a flexible educational system: A field study in Algerian universities

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Abstract:

The aim of this study is to propose a novel perspective on the educational process to build a better future for education through the integration of modern technologies such as cloud computing, blockchain, and artificial intelligence, we undertook a comprehensive evaluation of the e-learning experience within Algerian universities, employing two questionnaires which were disseminated to both students and faculty members via the official website of the Ministry of Higher Education, we meticulously analyzed a substantial corpus of data consisting of 13389 student questionnaires and 7546 faculty questionnaires, The salient findings of our study unequivocally signify that the e-learning experience garnered a predominantly favorable appraisal, thus underscoring the unequivocal positive influence of modern technologies on the realm of education.

Keywords: Crisis, Blockchain, Artificial Intelligence, Cloud Computing, E-Learning.

Jel Classification Codes : I21, I23, J24, O32.

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1. Introduction:

Education worldwide has undergone an unprecedented transformation since the onset of 2020, In response to the imperative of curbing the spread of COVID-19, a paradigm shift towards digital education was necessitated, This pivotal change has positioned technology and modern advancements as the world's saviors from the virus and as a means of preventing its dissemination, notably this crisis has yielded significant outcomes by opening new horizons for innovation in educational practices and mechanisms.

Adopting a positive perspective on this crisis, it can be viewed as an opportunity for "building back better," The strategies employed to recover from this crisis can serve as a foundation for introducing radical improvements and embracing a fresh perspective on educational methods that align more closely with the demands of our current era, as revealed by the pandemic that has swept the globe, Presently, we find ourselves grappling with a technologically driven generation, residing in the digital knowledge age, Modern technologies and the digital realm have become omnipresent, permeating every facet of life, and transforming into necessities.

However, the field of education has lagged behind in fully embracing this transformative wave, Consequently, the challenge faced by the education sector today stands as one of the most significant obstacles of our modern era, Hence, it has become an urgent necessity to harness and rely upon modern technologies in order to elevate the education sector to a higher and more advanced level.

1.1. Study problem: Considering the present era, the future of education is intricately entwined with innovative educational practices, Hence, the primary query arises: "**What are the modern technologies and innovative mechanisms that should be employed to build a flexible virtual educational system? what is the current status of Algerian universities in regard to this transformative shift?**

1.2. Study hypotheses: The main question and sub-questions can be answered by testing the following hypotheses:

- Novel mechanisms in education will emerge as a result of the crisis.
- The experience of e-learning in Algerian universities has a positive impact.

1.3. The importance of the study: The significance of this study is highlighted by the timeliness of the subject, particularly in the aftermath of the COVID-19 crisis, which has underscored the importance of integrating modern technologies in education.

1.4. Study Objectives: The objectives of this study are as follows:

- Clarifying the Role of Cloud Computing as a Means to Enhance E-Learning;
- Blockchain Technology as the Solution for Constructing the Desired System؛
- Leveraging Artificial Intelligence to Contribute to the Development of a Flexible Learning System.

1.5. methodology of the study: This study involved two variables:

- The independent variable: It encompasses modern and advanced technologies, including e-learning.
- The dependent variable: The educational process in Algerian universities.

Therefore, a descriptive analytical approach was adopted to align with the study's variables. This approach is one form of scientific analysis and interpretation aimed at describing the phenomenon as it exists, elucidating its dimensions, understanding its various aspects, and monitoring its development over time. The purpose is to comprehensively encompass the subject matter, followed by its analysis, interpretation, and correlation with other phenomena.

2. Literature Review:

2.1. The crisis of COVID-19 and its impact on moving towards a better future for education:

Universities have transitioned to E-learning in order to slow down the spread of the COVID-19 pandemic, However, what we have learned from this experience aligns with the saying "every cloud has a silver lining", Without the COVID-19 pandemic, Arab and developing countries may not have been motivated to embrace the digital world, The impact of the COVID-19 virus in a matter of months surpassed what these countries had accomplished in decades.

Therefore, we hope that this significant leap towards digitalization becomes a starting point for accessing the virtual and digital world in all fields, especially in education, Global trends in education development, particularly higher education, are closely linked to the integration of technology in education Traditional education systems no longer meet the requirements of a society transitioning into a knowledge-sharing community and do not align with the era we live in Accelerating the integration and use of modern technology in education will help facilitate the transition from direct learning to intelligent learning (Chine, 2009, p 752).

With technological openness, especially with the growth of information and communication technologies (ICT), higher education has been significantly affected worldwide, The educational environment is rapidly moving towards using ICT as an instructional method to reshape traditional education and transform it into intelligent education, As a result, smart learning environments have been designed and built to enhance learning in a better, faster manner, with the belief that traditional learning methods will become extinct (Alajmi Q, 2020, p 13).

2.2. Transitioning to Cloud Computing to Enhance the Shift towards E-Learning:

Cloud computing is considered one of the most effective and popular systems for digital transformation, it represents a new model of computing that relies on networked computers, it serves as the fundamental environment and platform for the future of e-learning, providing data storage, internet services, and powerful computational capabilities (Hurwitz, 2010, p 90) Therefore, initially, what exactly is cloud computing?

2.2.1. Concept and Components of Cloud Computing: The concept of cloud computing began with what is known as cloud storage, which refers to storing data and files on the internet instead of traditional storage devices like hard drives, external drives, or flash disks, With the emergence of cloud platforms such as OneDrive, Google Drive, SkyDrive, and iCloud, we started storing our files on the internet This allows us to access and utilize this data anytime, anywhere, as long as we have an internet connection .

Therefore, cloud computing involves the transfer, processing, and storage of computer-related tasks to the cloud, which acts as a server accessed through the internet, it consists of the essential components depicted in the following model (Marwa, 2012, p 600).

Fig N° 01: components of cloud computing.

Source: (Rayport J.F. and A. Heyward, 2009, p 35).

2.2.2. Relationship between E-learning and Cloud Computing: These two systems together create an environment in which users only need a portable device such as a mobile phone, tablet, or PC, The key components of E-learning include hardware, software, and platform, all of which can be facilitated by cloud computing, Users can store and retrieve data on the cloud from anywhere and at any time, benefiting from resource pooling, on-demand self-service, and broad network access, among other features, However many universities face challenges in implementing E-learning systems due to limited infrastructure and resources, As a result, platforms like Moodle and Blackboard have developed cloud-oriented applications to address these limitations (Tamara Almarabeh & Yousef Kh. Majdalawi, 2018, p 14).

Cloud-based education relying on cloud computing is one of the successful technologies in the field of information technology, it enables the delivery of effective e-learning products using cloud computing services, with this technology, it becomes possible to create a complete world of knowledge online and provide it to professors and students through cloud-based services accessible anytime, anywhere, and on any device.

This is achieved by accessing e-learning applications based on cloud computing, utilizing the services provided by the cloud, such as big data storage and high-speed processing, However, there are still some shortcomings in terms of platform security and unresolved technical and regulatory standards, Nevertheless, the progress of cloud-based e-learning applications will continue with the advancement of cloud computing

technologies and their widespread adoption, As these technologies evolve, e-learning will enter a new era, characterized by flexibility as one of its key features (Milind Patil, June 2022, p 1832).

2.3. Blockchain the Solution for Digitizing the Higher Education System: Before delving into how blockchain technology will enhance the transition of education to the digital world in its interactions with employees, professors, and students, it is important to understand what blockchain technology is "Bitcoin: A Decentralized Electronic Currency System" is the heading of a paper that first introduced the concept of blockchain, This groundbreaking publication emerged in 2008, attributed to an individual or a group of individuals under the pseudonym "Satoshi Nakamoto" The term "Blockchain" was coined to describe the fundamental framework on which the electronic currency system, known as Bitcoin, was presented in the paper (Subaie, 2019, p 4).

Blockchain is a technology that forms a decentralized and distributed database, it allows data to be uploaded only by authorized entities and prevents data from being updated or deleted Therefore, blockchain technology has the capability to prevent tampering or forgery of files and certificates (Christidis, 2016, p 2298). Employing blockchain technology in higher education will increase transparency, integrity, and efficiency in various aspects of the education system, here are some examples of its uses:

- **Digital Records:** The use of blockchain technology enables the creation and management of a digital database for certificates, diplomas, and administrative files, These records can be safeguarded through encryption codes, offering a more secure and transparent approach to storing and sharing data with authorized entities such as the Ministry of Higher Education, social security institutions, and university administrations, Each professor or staff member has the ability to access their digital data and share it with authorized parties for data access (Sharma & Batth, June 2020, p 350).
- **Student Files:** Blockchain technology can be employed to establish a centralized system for storing and sharing student records and certificates, ensuring that students can conveniently access their certificates in a secure and transparent manner, This can be accomplished through collaboration between educational institutions and authorized entities such as the Ministry of Higher Education, the Ministry of Social Security, and others (Palma, Vigil, Pereira, & Martina, 2019, p 29).

Fig N° 02: A Model for Blockchain Adoption in Universities

Source: (Dongol, 2020, p 16)

In the field of education, Gulf universities and institutions have embraced blockchain technology to enhance the issuance, authentication, and verification of academic certificates, The University of Bahrain started issuing digitally encoded diploma certificates using blockchain and machine learning in 2019, Likewise, the British University in Dubai introduced blockchain-based certificates in 2018, simplifying the authentication and verification process for graduates, educational institutions, and employers. By scanning the embedded code on the certificate through a designated link on the university's website, immediate access to all necessary information for authentication and verification within the blockchain network is granted (Subaie, 2019,p 4).

2.4. Artificial Intelligence: The Future Paradigm for Virtual Education: The globalization of education has fueled the imagination of technological advancements, opening doors and horizons for innovation in the future of education; Modern technologies have rapidly evolved, with artificial intelligence (AI) being one of its prominent features, thanks to its remarkable capabilities.

The term "artificial intelligence" was coined by American scientist McCarthy Johan in 1956, defining it as the science and engineering of intelligent machines; AI is characterized as computer programs that analyze and process information using knowledge-based procedures to solve complex problems that are difficult for humans to tackle due to the extensive expertise required (Wong, 2009, p 62).

Artificial Intelligence (AI) is defined as "intelligent computer programs that analyze and process data using knowledge-based procedures to solve complex problems that are difficult to solve due to their requirement of significant human expertise; " AI systems are designed to simulate human intelligence and perform tasks that typically require human cognitive abilities, such as learning, reasoning, problem-solving, and decision-making (Wong, June 2009), Educational institutions are optimistic about the potential of AI to streamline administrative and academic responsibilities, enhance the efficiency of IT processes, address enrollment challenges, and provide an enhanced learning experience for students; These advancements are already being witnessed in certain campuses (Neelakantan, 2020, p 2).

The design of AI software and applications involves studying how the human mind thinks, learns, makes decisions, and works to solve problems; The findings from these studies are then utilized as a foundation for developing intelligent software and systems (Mousa, 2019, p 61).

Consequently, we can infer that artificial intelligence is a computer science discipline that aims to simulate human intelligence; For example, one of the applications of artificial intelligence is the use of mobile phone programs that recognize voices and individuals, as well as provide personalized recommendations when browsing the internet or social media platforms; additionally one of the significant uses of artificial intelligence is self-driving smart cars that can identify roads and traffic signs, reducing traffic accidents Hence, we can

acknowledge the role of modern technology in facilitating our lives Now, let us imagine harnessing this cutting-edge technology, artificial intelligence, in the field of education, envisioning the remarkable outcomes and groundbreaking transformation in the future of learning.

3. The practical side:

3. 1. Statistics and Evaluation of the Experience of E-Learning in Algerian Universities: Regarding the Algerian experience in utilizing e-learning and distance education, it is still in its early stages and varies in its progress; This can be attributed to a lack of awareness about the effectiveness of this type of education and its contribution to enhancing individuals' academic and professional capabilities.

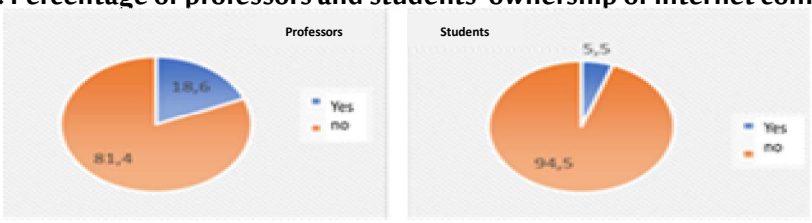
3.2. Study and Sample: Therefore, we conducted a study to assess the current state of e-learning through two questionnaires distributed across all Algerian universities via the Ministry of Higher Education platform, The study targeted both students and professors in 107 educational institutions and 14 academic disciplines nationwide. The surveys consisted of one questionnaire designed for professors and another for students, The study took place from June 24, 2021, to July 5, 2021.

We received a total of 87094 student responses and 26943 professor responses, out of these, 13389 student questionnaires and 7546 professor questionnaires were successfully processed, the questionnaire was divided into four main axes, as follows:

4. Results and discussion:

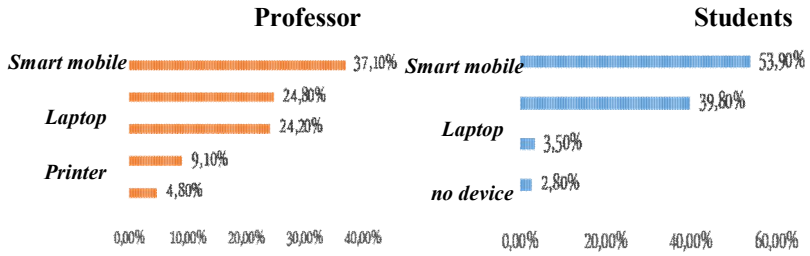
4.1. The First Axis: Quality and Type of Devices and Internet Network Used: The first axis of the study focuses on assessing the quality and type of devices and internet networks used by students and professors in the context of e-learning; This axis aims to evaluate the technological infrastructure available to support effective online education, The following aspects are considered:

Fig N° 03: Percentage of professors and students' ownership of internet connection network.



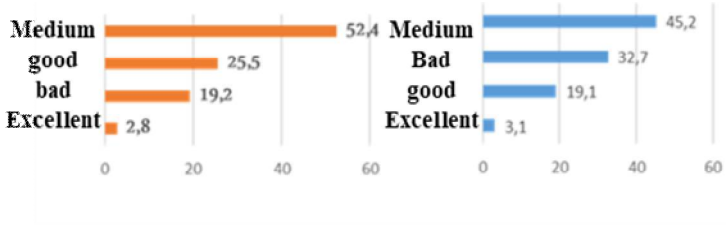
Source: Prepared by the researcher based on the questionnaire data

Fig N° 04: The percentages of electronic devices used to connect to the internet.



Source: Prepared by the researcher based on the questionnaire data

Fig N° 05: Internet Network Quality Ratios



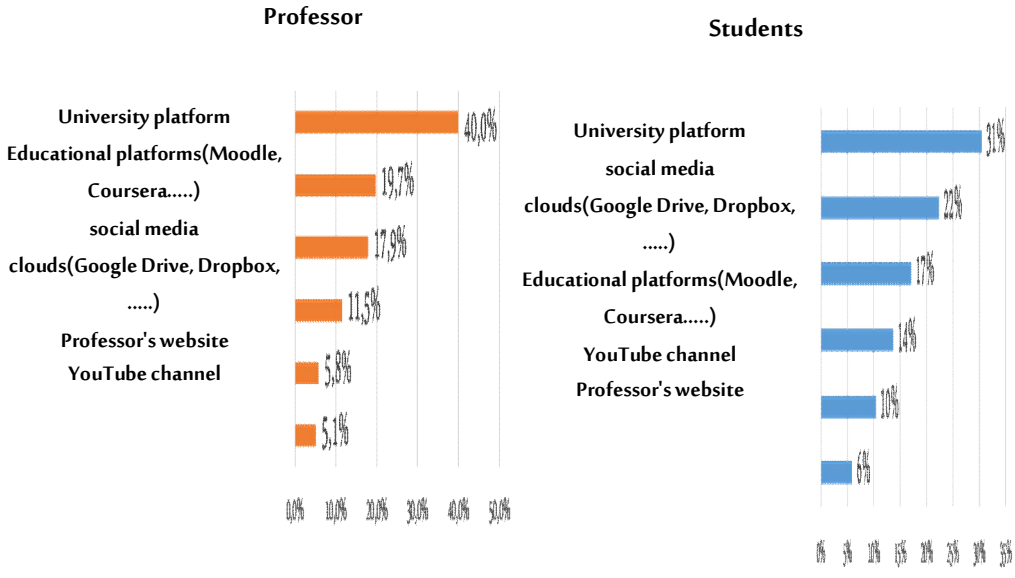
Source: Prepared by the researcher based on the questionnaire data

Based on the previous results, it is evident that both professors and students had a high access rate to the internet network, The percentage ranged from 94.5% for professors to 81.4% for students, This can be attributed to the fact that the internet has become a necessity in life and is classified as a primary need according to Maslow's hierarchy of needs, The provision of internet access through mobile phone services has had an impact on the obtained results; Around 53.90% of students use smartphones to connect to the internet, while among professors, the primary device used is the computer, with a percentage of 37.10%, This can be attributed to the nature of their work, However, the major concern is the quality of the internet connection among students, which was rated as poor or average by 32.7% and 45.2% respectively, This is primarily due to the use of mobile network connections, On the other hand, 52.4% of professors found the network connection to be average, mainly because they frequently use ADSL connections.

By analyzing the data collected in this axis, we can gain insights into the quality and suitability of the devices and internet networks used in the Algerian e-learning context, The findings will help identify areas that require improvement and investment to ensure equitable access and enhance the overall e-learning experience.

4.2. The Second Axis: Educational Programs and Platforms Used

Fig N° 06: Percentage of programs and platforms utilized for e-learning.



Source: Prepared by the researcher based on the questionnaire data

Tableau 01: Percentage of preferred pedagogical tools for e-learning

pedagogical means	Videos online	electronic lectures	documents, PDF, Doc	Electronic conversation
Professor ratios	%13,20	%18	% 52,50	%16,30
Student ratios	%12	% 20	% 49	%19

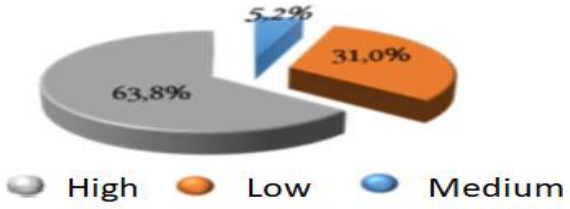
Source: Prepared by the researcher based on the questionnaire data

Based on the previously presented results, it can be observed that both professors and students primarily use the university's e-learning platform. The usage rate was high for both groups, with 40% for professors and 31% for students. This platform serves as the main channel for professors to upload their lectures and for students to access them. From this, we can conclude that this type of education is remote learning rather than solely electronic.

In the second rank, professors show a preference for educational platforms, accounting for 19.7%, This indicates that professors are aware that e-learning takes place through these platforms; On the other hand, students rank these platforms in fourth place, showing a greater inclination towards social media platforms, which rank second From this, we can infer that students may not fully grasp the nature of e-learning, as they have not received any prior training in this field before the crisis.

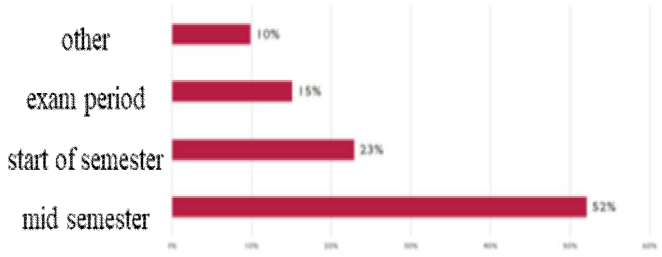
4.3. The Third Axis: Students' Engagement and Interaction with Online Lectures

Fig N° 07: Percentage of students following online lectures.



Source: Prepared by the researcher based on the questionnaire data

Fig N° 08: Percentage of students accessing online lectures regularly.



Source: Prepared by the researcher based on the questionnaire data

From the above, it can be observed that the high attendance of students in online lectures indicates their preference for accessing digital lectures and downloading them for convenient access anytime and anywhere, the attendance rate reached 63.8%. Regarding the duration of access, it was observed to occur between the examination period and the midpoint of the semester.

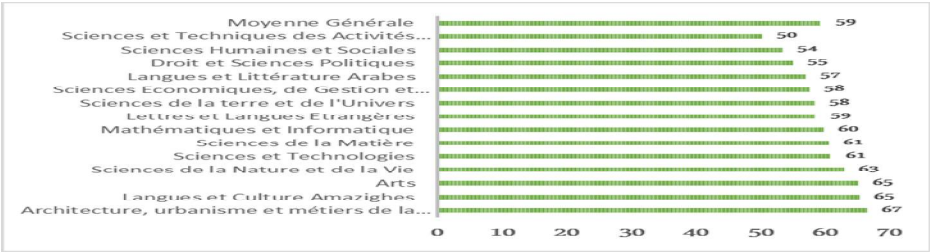
4.4. The Fourth Axis: Course Completion and Achieved Results

Table02: Percentage of university course completion through e-learning

institutions	University centers	high schools	National Polytechnic School	National School of Architecture	universities
percentage	%60	%62	%66	%75	%59

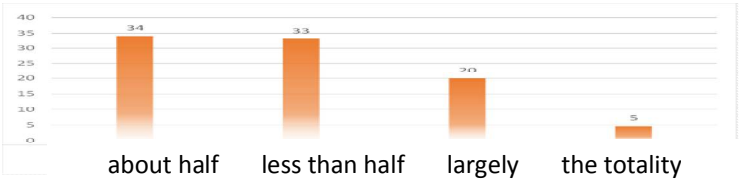
Source: Prepared by the researcher based on the questionnaire data

Fig N° 09: Percentage of completed university courses disciplines.



Source: Prepared by the researcher based on the questionnaire data

Fig N° 10: Percentage of students' cognitive achievement through e-learning

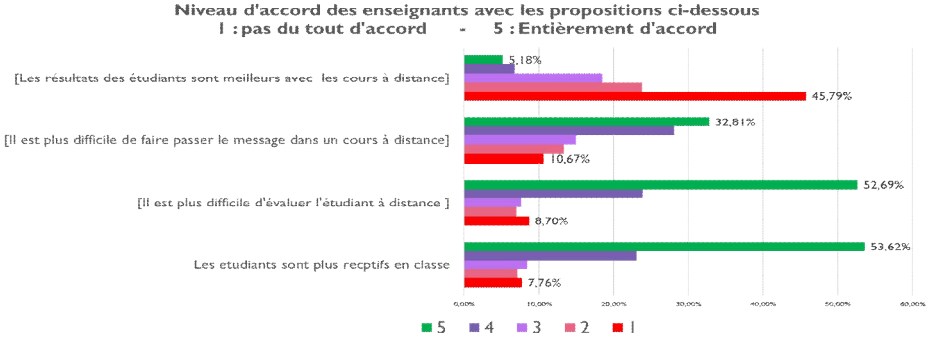


Source: Prepared by the researcher based on the questionnaire data

The National School of Architecture ranked first in the completion of annual courses through the use of online education, with a rate of 75%. The second and third positions were also held by the National School of Multimedia Technologies and Higher Schools with percentages of 66% and 62%, respectively, The universities obtained the last position with a percentage of 59%; This can be attributed to the fact that students and professors in the National and Higher Schools rely on submitting assignments and communicating via email However, the academic achievement based on the obtained results was evaluated as average to below average.

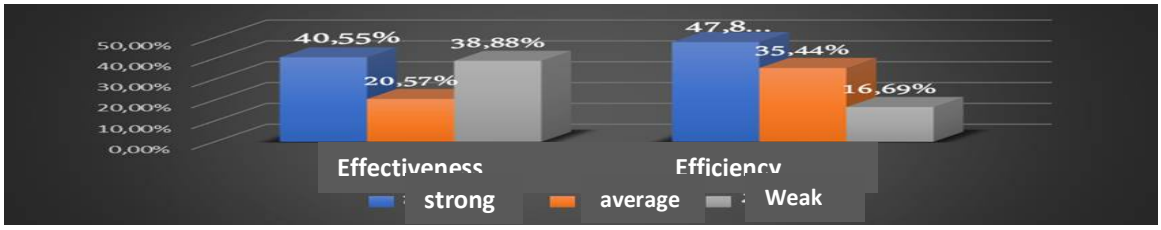
4.5. The Fifth Axis: Evaluation of the E-Learning Experience

Fig N° 11: Evaluation of the e-learning system by professors



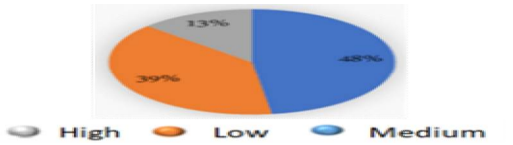
Source: Prepared by the researcher based on the questionnaire data.

Fig N° 12: Evaluation of the effectiveness and efficiency of the e-learning system by professors



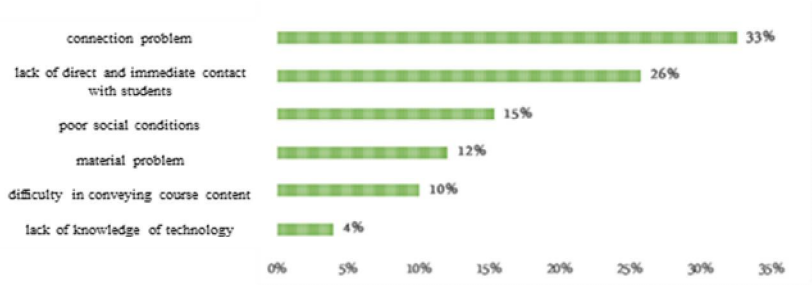
Source: Prepared by the researcher based on the questionnaire data

Fig N° 13: Students' evaluation of their learning experience through e-learning



Source: Prepared by the researcher based on the questionnaire data

Fig N° 14: Challenges encountered by professors when uploading lessons on e-learning platforms.



Source: Prepared by the researcher based on the questionnaire data

From the perspective of professors, the evaluation of remote learning based on the previous information was generally considered acceptable in terms of effectiveness and efficiency However, students' evaluations ranged from average to weak; This can be attributed to the obstacles they encountered, such as slow and weak internet connection, the absence of direct communication that both students and professors are accustomed to in traditional learning, lack of equipment, professors' lack of proficiency in preparing electronic lectures, and the inability to effectively convey lecture details to students Additionally, the lack of technological control also played a role in these evaluations.

5. Conclusion:

Incorporating modern technology into the educational process is a crucial step in improving the quality of education and providing innovative and effective learning experiences, Technology can enhance interaction and active participation, as well as enable self-directed learning through the use of modern technology; by harnessing modern technology in education, we can build an advanced educational future that meets the needs and aspirations of society in the era of technology .The utilization of modern technology in the educational process offers new opportunities for innovation; it goes beyond the use of smart devices and technological applications to include a diverse range of innovative and modern tools and technologies that bring a more

immersive, optimized, and enjoyable learning experience, Examples include virtual reality, augmented reality, intelligent learning, e-learning, artificial intelligence, blockchain, and more.

The education system followed by Algerian universities is a form of distance learning rather than purely online learning, This is due to the lack of experience in this field, as two-thirds of professors and students admit to not having received sufficient information or appropriate training; the educational institutions primarily rely on institutional platforms according to students and professors, while social networking platforms rank second in students' preferences; all of this is attributed to the suddenness of the pandemic and the transition to online or distance learning as the only solution for the continuity of education.

We can consider the achievements of distance learning during the crisis to be acceptable to some extent, it helped us avoid a blank academic year and enabled us to somewhat complete the curriculum; however, when evaluating its effectiveness and efficiency, the results are low, this is due to several factors mentioned earlier, such as the lack of experience, training, and the previous reliance on hybrid learning instead of direct teaching, the most significant obstacle is the weak internet connectivity, which hampers the flow of communication.

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