PAPER

Impact of E-learning Tools (Moodle, Microsoft Teams, Zoom) on Student Engagement and Achievement at Jordan Universities

Zaid Khrisat[1](✉), Hussam N. Fakhouri[2]

[1]Faculty of Arts and Educational Sciences, Middle East University, Amman, Jordan

[2]Data Science and Artificial Intelligence Department, University of Petra, Amman, Jordan

zkhrisat@mau.edu.jo

ABSTRACT

This study examines the impact of digital learning platforms—Moodle, Microsoft Teams, and Zoom—on student engagement and academic achievement at the University of Jordan. The study explores students' familiarity with these e-learning tools and their effect on self-directed learning and performance. Over three months, data was collected from 450 students through an online questionnaire comprising closed questions. The analysis employed multiple regression models to consider variables such as gender, age, prior computer literacy, attitude towards emerging technology, learning preferences, and the implementation of e-learning within the university. Additionally, a qualitative content analysis identified the advantages and disadvantages of e-learning from the students' perspectives. The findings indicate that strategic implementation of e-learning platforms significantly influences student perceptions more than individual contextual factors. Students appreciated the connectivity and accessibility provided by these platforms. Those with prior computer knowledge and those studying emerging technologies showed a particularly positive attitude towards e-learning. The study concludes that engagement with e-learning tools markedly enhances self-study habits and academic performance, underscoring the importance of integrating digital platforms into educational strategies.

KEYWORDS

e-learning, Zoom, Microsoft Teams, artificial intelligence

1 INTRODUCTION

The advent of digital learning platforms has revolutionized traditional educational methods, allowing institutions to extend their educational reach beyond physical classrooms and enabling continuous, flexible learning experiences. These platforms are not merely tools for content delivery; they also facilitate interactive and adaptable educational processes. With the rapid expansion of these technologies

in educational settings, evaluating their reception by students and their efficacy in supporting the educational community is critical [2].

Moodle, Microsoft Teams, and Zoom represent a spectrum of digital tools utilized within educational settings, facilitated by information and communication technologies (ICT). These platforms are integral components of contemporary education systems, enabling asynchronous and synchronous learning environments where direct interpersonal interactions may not always occur [3]. As ICT continues to evolve, the utilization of these technologies in educational contexts, both within classrooms and at a broader institutional level, remains pivotal. The application of such digital tools extends beyond traditional academic settings into corporate environments, where they serve as mediums for employee training through corporate networks.

The pedagogical models supported by these platforms leverage multimedia and digital communication tools such as television and the Internet, transcending the physical limitations of conventional classroom setups [4]. This evolution in educational delivery breaks down geographical barriers and shifts the traditional educational paradigms from a classroom-centric to a more flexible, user-oriented approach. Learners, often characterized as nontraditional "amateur" in their educational pursuits, benefit from the versatility of these models. They are afforded the flexibility to engage with educational content from any location and at any time, without the necessity of being physically present in a specific location.

This model facilitates a diverse array of learning modalities, including face-to-face interactions in a virtual space and the use of varied instructional media [5]. Students can interact with tutors through digital platforms, engage with learning materials via television or the Internet, and participate in virtual classrooms. Such flexibility not only enhances accessibility but also caters to a wider range of learning preferences and schedules, thereby enriching the educational experience and potentially increasing the efficacy of learning outcomes.

The impact of modern information technology on higher education has been profound, with ICT becoming a cornerstone of educational activities at universities. As technology advances, its integration into educational processes deepens, prompting the emergence of innovative approaches such as the design and online dissemination of course content in higher education. Over the past two decades, academic institutions have increasingly embraced diverse ICT systems, including learning management systems (LMS) such as Moodle, Microsoft Teams, and Zoom [6]. These platforms facilitate a blend of asynchronous remote learning, online courses, and assessments, alongside traditional face-to-face lectures and digital teaching content.

Most universities in Jordan, responding to the need for enhanced educational delivery, have significantly invested in these ICT systems to equip their educational frameworks with the necessary technological support [7]. Such investments enable educators to augment their teaching methods and instructional programs, integrating traditional and open-source platforms for e-learning. These platforms serve not only as repositories for digital content hosted on university web servers but also as dynamic environments for student interaction and engagement [47].

The adoption and efficacy of Moodle, Microsoft Teams, and Zoom in educational settings are influenced by a myriad of factors, including individual self-efficacy, age, educational background, and employment status. Furthermore, both physical and psychological elements within the digital learning environment can either foster or hinder students' attitudes and performance. According to [8], the physical setting and psychological climate of the learning environment play crucial roles in shaping educational outcomes [46].

Beyond the technological aspects, it is vital to consider the social dynamics that underpin e-learning. Shared values between students and instructors, along with

the overarching educational culture, significantly impact the effectiveness of digital learning tools. Triandis [9] introduces a behavioral framework comprising affective, cognitive, and behavioral components. The affective dimension relates to emotions and feelings towards the learning platforms—likes and dislikes [42]. The cognitive dimension involves rational beliefs and perceptions about the utility and functionality of the ICT tools. Lastly, the behavioral aspect describes the actual use and engagement with the platforms by educators and learners [43].

Together, these dimensions contribute to a comprehensive understanding of e-learning adoption, helping to elucidate how Moodle, Microsoft Teams, and Zoom shape educational experiences and outcomes. This multifaceted approach underscores the importance of viewing e-learning tools within the broader context of their social, psychological, and technological impacts on the educational landscape [10, 44, 45].

This study will explore various dimensions of digital learning, such as student engagement, the accessibility of learning materials, ease of use, and overall satisfaction with the platforms used. A quantitative methodology will be employed, involving a questionnaire administered to 450 students from different faculties and levels of study. The responses will be analyzed using multiple regression to explore the correlation between demographic and academic variables and students' perceptions of e-learning.

1.1 Research problem

The study problem focuses on the imperative to understand the effectiveness and impact of digital learning platforms such as Moodle, Microsoft Teams, and Zoom on student engagement and academic performance at Jordan universities. As educational institutions increasingly integrate digital and remote learning modalities, there is a pressing need to evaluate how these platforms are received by students and how they influence learning outcomes.

The digital transformation in education, driven by advancements in ICT, has revolutionized traditional educational methods. These platforms offer flexible, continuous learning opportunities that extend beyond the physical classroom, enabling students to access educational materials and engage in interactive learning processes at their convenience. Despite the widespread adoption of these technologies, there is a significant gap in understanding how they affect student behavior, self-study habits, and overall academic achievement.

This study addresses the critical need to assess the reception and efficacy of e-learning tools from the student perspective. It aims to explore the relationship between students' attitudes towards e-learning and various contextual factors, such as academic level, age, prior computing experience, and learning preferences. By doing so, the study seeks to identify the key benefits and drawbacks of e-learning, providing valuable insights that can inform future educational strategies and policies. The findings will contribute to optimizing the implementation of e-learning platforms, ensuring they effectively support student engagement and enhance academic performance in higher education settings.

1.2 Aim of the study

The principal aim of this investigation is to delve into the pivotal factors for resolving challenges in e-learning education through platforms such as Moodle,

Microsoft Teams, and Zoom from the student perspective. The study is structured to fulfill three specific objectives: firstly, to scrutinize students' general behaviors and interactions within e-learning environments; secondly, to analyze the relationship between students' attitudes toward e-learning and various contextual influences, such as academic level, age, prior computing experience, digital technology attitudes, and learning preferences; and thirdly, to identify and discuss the foremost benefits and drawbacks of e-learning as they pertain to self-study and academic achievement. The study engages with a substantive initial sample of 450 students, employing methodological approaches that will be elucidated in this report, encompassing the processes of data collection, response rates, population and sample analysis, questionnaire development, and the statistical methods applied.

1.3 Contribution

The findings from this study provide valuable insights into the impact of digital learning platforms on student engagement and academic performance, with significant implications for the broader educational community. By examining the experiences and perceptions of students at Jordanian universities, this study contributes to a deeper understanding of how e-learning tools such as Moodle, Microsoft Teams, and Zoom can be effectively integrated into higher education.

Firstly, the study highlights the critical role of strategic implementation of e-learning platforms in enhancing student engagement and academic outcomes. By identifying key factors that influence the effectiveness of these tools, the study offers practical recommendations for educators and policymakers to optimize the use of digital platforms in educational settings. This can lead to improved instructional strategies, better resource allocation, and the development of more supportive digital learning environments.

Secondly, the study underscores the importance of addressing individual differences among students, such as prior computer literacy, attitudes towards emerging technologies, and learning preferences. By acknowledging these differences, educational institutions can tailor their e-learning approaches to meet the diverse needs of their student populations, thereby promoting inclusivity and accessibility in education. Furthermore, the study's findings on the benefits and drawbacks of e-learning provide a comprehensive perspective that can inform future developments in digital education. By understanding the specific challenges and advantages associated with e-learning, educators can develop more effective teaching methods and support systems that enhance students learning experiences and outcomes.

2 RELATED WORK

This section reviews the most recent related work in the field. One of the recent studied is Sekine et al. (2022), who have investigated the impact of the COVID-19 pandemic on Japanese medical students, with a focus on their attitudes towards e-learning and its correlation with their performance on achievement tests. The study uncovered a preference for asynchronous classes among preclinical students and indicated that students who preferred face-to-face learning tended to achieve higher scores, thus highlighting the complex influence of e-learning modalities on academic performance [11]. Moreover, Kaharuddin (2022) evaluated the effectiveness of various teaching methods—specifically the grammar translation method

and the direct method—on students' English competence during the pandemic. The study revealed significant direct and indirect effects of these methods on learning outcomes when implemented through e-learning platforms such as Zoom and Google Classroom, pointing to the critical role of methodological adaptation in virtual environments [12].

Furthermore, Kong et al. (2021) explored the effects of e-learning-based exploratory education on students' self-efficacy and interpersonal relationships within a Chinese university context. Their findings emphasized the positive impacts of exploratory educational practices on students' self-management and social interactions, thereby underscoring the broader developmental benefits of well-structured e-learning experiences [13]. In another study, Aissi and Mouas (2024) assessed the perceptions of Algerian university teachers concerning personalized positive feedback via Moodle and its impact on student motivation and engagement. While recognizing the potential benefits, the study revealed only weak correlations between teachers' expertise with Moodle and the effectiveness of personalized feedback, indicating opportunities for improvement in both teacher training and technological utilization [14].

ElSabagh (2021) delved into the efficacy of an adaptive e-learning environment tailored to students' learning styles and its role in enhancing engagement. The study demonstrated that adaptive e-learning significantly enhanced student engagement compared to traditional e-learning approaches, advocating for the adoption of more personalized and flexible educational technologies to optimize learning outcomes [15]. Yustina et al. (2022) examined the efficacy of the problem-based learning (PBL) model implemented via e-learning at an Islamic senior high school in Indonesia, focusing on its impact on students' creative thinking skills. Utilizing a quasi-experimental design, the study revealed that PBL significantly enhanced students' creative thinking, particularly in terms of originality and elaboration. This suggests that problem-based approaches are particularly effective in fostering critical thinking skills within virtual learning environments [16].

Alsoud and Harasis (2021) assessed e-learning experiences among university students in Jordan during the pandemic. Their findings indicated that students from remote and socioeconomically disadvantaged areas encountered significant challenges, such as poor Internet connectivity and inadequate learning environments. The study calls for further investment in educational infrastructure to support effective distance learning across diverse socioeconomic landscapes [17]. Sulaymani et al. (2022) investigated the factors influencing younger learners' acceptance of e-learning platforms in Saudi Arabia. The study identified previous technological experience and self-efficacy as critical determinants of students' engagement with e-learning. Notably, the study found that these impacts varied across different age groups and genders, underscoring the need for e-learning interfaces that are both user-friendly and supportive of social interactions to enhance platform acceptance among younger demographics [18].

Karimi et al. (2023) investigated the effectiveness of a blended e-learning approach for nursing students in Iran, focusing on cognitive and psychomotor learning outcomes. The study demonstrated that incorporating visual, analytical, and practical components into e-learning significantly improved learning outcomes, highlighting the benefits of integrating multiple learning modalities to support the development of the complex skill sets required in nursing [19]. Kim and Park (2021) analyzed the relationship between learning flow, e-learning satisfaction, and learning outcomes among nursing students in South Korea, with particular attention to the moderating effect of social evaluative anxiety related to COVID-19. Their findings illustrated

that while e-learning satisfaction generally mediated the relationship between learning flow and outcomes, the presence of COVID-19-related anxiety negatively impacted this mediation. This indicates a pressing need for strategies to alleviate pandemic-related anxieties and optimize e-learning outcomes [20].

In recent study, Zhao et al. (2021) proposed and validated a model to examine how environmental psychology, e-learning, learning styles, and school design influence the behavior of elementary students. Utilizing data from 400 teachers in Iran, the study affirmed the model's effectiveness, illustrating the significant effects of environmental psychology and school design on student behavior. This study stresses the intricate relationship between physical learning environments and e-learning dynamics, emphasizing their joint importance in optimizing student behavior and learning outcomes [21].

Goosse et al. (2023) investigated the influence of e-learning integrated with role play on the communication skills of psychology students through a methodology known as cumulative micro training (CMT). The findings indicated substantial improvements in communication skills, including empathy and confidence, thereby demonstrating the value of hybrid training models in enhancing key professional skills within educational frameworks. This supports the broader adoption of such integrated training approaches in psychology education [22]. Nurfitriyani and Legowo (2023) explored the determinants of student satisfaction and perceived learning outcomes using Zoom in university settings in Jakarta, Indonesia. The study underscored the critical roles of perceived usefulness, system quality, and personal enjoyment in elevating both student satisfaction and learning outcomes. Reflecting on the pivotal importance of technology quality and user experience, this study underscores the efficacy of platforms such as Zoom in delivering effective online education [23].

Cheng et al. (2024) focused on the impact of case-based teaching videos on e-learning platforms on self-regulated learning outcomes among social work students in Taiwan. The study highlighted that these videos significantly boost students' motivation and information processing capabilities, especially when these videos are connected to practical experiences. These insights advocate for the use of case-based teaching videos as a robust mechanism to foster self-regulated learning and enhance academic performance [24]. Peters et al. (2023) conducted a randomized controlled trial to evaluate the efficacy of head-mounted displays (HMDs) for teaching surgical suturing techniques to medical students, comparing their effectiveness with traditional e-learning and courses. The study found that HMDs provided a more immersive and effective learning experience, rivaling that of traditional sessions. This suggests that HMDs might serve as a superior alternative to conventional e-learning platforms, particularly in disciplines where visual and spatial experiences are integral to the educational process [25].

Qushtom et al. (2023) investigated the implementation of e-learning systems for teaching accounting at Jordanian universities. Their findings indicated a perceived decline in the acquisition of practical skills through e-learning compared to traditional methods, highlighting the challenges inherent in adapting e-learning systems for disciplines that require extensive practical training. The study calls for enhancements to these systems to better support the development of practical skills [26]. Alabdulaziz (2022) assessed the effectiveness of the PDEODE teaching strategy, which was supported by an e-learning environment, in developing mathematical understanding and problem-solving skills among primary school students. The results demonstrated significant improvements in both conceptual understanding and problem-solving abilities in students who engaged with the PDEODE strategy over

those who received traditional instruction, underscoring the potential of integrated e-learning strategies to bolster cognitive and analytical skills in young learners [27].

Dangaiso et al. (2023) evaluated the impact of quality antecedents on the continued intentions of university students to use e-learning systems post-COVID-19 in Zimbabwe. The study confirmed that system quality, instructor quality, and information quality significantly influence students' intentions to continue using e-learning, though support service quality was not found to have a significant impact. This finding suggests that educational institutions should prioritize these quality factors to sustain and enhance student engagement with e-learning platforms [28].

Rahman et al. (2023) analyzed factors influencing the acceptance of e-learning among community college students in Kelantan, Malaysia, following the COVID-19 pandemic. The study revealed that student motivation and computer competency significantly impacted students' behavioral intentions to persist with e-learning, whereas the influence of student mindset was less definitive. This highlights the necessity to address both motivational and technological competencies to promote e-learning acceptance in a rapidly evolving educational context [29].

Sobaih et al. (2022) explored the use of social network applications (SNAs) such as Facebook and WhatsApp for academic purposes in Egyptian higher education institutions. Despite initial skepticism regarding their educational effectiveness, the study revealed that SNAs had a positive impact on students' academic performance, suggesting their potential as viable e-learning platforms, particularly in settings with limited resources. This indicates that the accessibility and ease of use of SNAs can effectively complement traditional educational methods [30]. Ching and Maarof (2021) analyzed the relationship between e-learning quality, student satisfaction, and learning outcomes among Malaysian undergraduate nursing students. By applying the DeLone and McLean information systems success model, they discovered that both system quality and service quality significantly influenced student satisfaction, which in turn mediated the relationship between e-learning quality and learning outcomes. This highlights the critical role of high-quality e-learning systems in fostering student satisfaction and enhancing academic performance [31]. Ali Krishan et al. (2023) assessed the impact of e-learning on the motivation and academic success of Jordanian university students. The findings indicated that e-learning had a positive effect on both motivation and academic outcomes, primarily attributed to the flexibility and diversity of the educational techniques employed. The study emphasized the importance of effective communication between teachers and students in maximizing the benefits of e-learning [32].

These diverse studies underscore the multifaceted impacts of e-learning, emphasizing the need for tailored educational strategies that consider individual and contextual learner needs to optimize digital education tools. Such insights are crucial for educators, administrators, and policymakers striving to enhance e-learning applications in various educational settings.

3 METHODOLOGIES

The methodology of this study is designed to rigorously investigate the impact of digital learning platforms on student engagement and academic performance. Given the increasing integration of digital tools in higher education, it is essential to employ a thorough and systematic approach to understand their effectiveness. This section outlines the comprehensive processes involved in survey development, participant selection, data collection, and the advanced statistical analyses used to interpret the data.

A detailed and robust survey was meticulously developed and subjected to expert and scholarly review to ensure its validity and reliability. The survey aimed to capture a broad range of data regarding students' behaviors, interactions, and attitudes towards e-learning platforms such as Moodle, Microsoft Teams, and Zoom. Prior to its widespread deployment, the survey was piloted to refine the questions and confirm the accuracy and consistency of responses. The finalized survey was hosted online and targeted both graduate and undergraduate students. A total of 720 individuals were approached via pre survey email notifications, invitations, and confirmations. The survey was accessible for a week, resulting in 450 completed responses, achieving a response rate of 62.5%. The utilization of the required field option ensured a 100% effective response rate.

Data was collected through a structured online questionnaire that included closed questions designed to capture quantitative data on students' familiarity with and attitudes towards e-learning platforms. The survey covered various aspects, such as prior computer literacy, attitudes towards emerging technology, learning preferences, and the implementation of e-learning within the university.

The collected data was subjected to rigorous statistical analysis to derive meaningful insights and conclusions. The primary analysis method was multiple regression, which allowed the studied to examine the relationships between students' attitudes towards e-learning and various demographic and contextual factors, such as gender, age, prior computing experience, and academic level. This approach enabled the identification of significant predictors of student engagement and academic performance. Additionally, the study employed quality content analysis to assess the qualitative aspects of the survey responses. This method helped identify the key advantages and disadvantages of e-learning as perceived by the students, providing a comprehensive understanding of the impact of digital learning platforms.

The analysis methods included descriptive statistics, multiple regression analysis, factor analysis, and quality content analysis. Descriptive statistics were computed to summarize the demographic characteristics of the participants and their responses to the survey questions. Multiple regression analysis was used to explore the relationships between the dependent variable (students' attitudes towards e-learning) and several independent variables (gender, age, prior computing experience, digital technology attitudes, and learning preferences). This method helped identify the significant predictors and quantify their impact on student engagement and academic performance. A factor analysis was conducted to identify the underlying factors that influence students' perceptions of e-learning platforms. This technique reduced the data complexity and highlighted the core dimensions that affect students' engagement and academic outcomes. To complement the quantitative analysis, a quality content analysis was performed on open survey responses. This analysis identified recurring themes, advantages, and disadvantages of e-learning platforms, providing deeper insights into the qualitative aspects of students' experiences.

4   INSTRUMENTS

The instruments used in this study were carefully designed to gather comprehensive data on students' perceptions of e-learning platforms (Moodle, Microsoft Teams, and Zoom), their impact on self-directed learning, and academic achievement. The primary instrument was a structured online questionnaire, which was developed through a rigorous and systematic process to ensure validity and reliability.

4.1   Development of the instrument

The development process of the questionnaire involved several key stages:

Initially, a thorough literature review was conducted to identify existing instruments and frameworks that have been used to evaluate e-learning platforms and their impact on student engagement and academic performance. This review provided a foundation for developing the questionnaire items, ensuring that they were grounded in established study and addressed relevant aspects of e-learning.

Following the literature review, a preliminary version of the questionnaire was drafted. This version was reviewed by a panel of experts in the fields of educational technology, instructional design, and higher education. The experts provided feedback on the content validity of the items, ensuring that they accurately captured the constructs being measured. Based on their feedback, revisions were made to refine the questionnaire items and improve their clarity and relevance.

The revised questionnaire was then subjected to pilot testing with a small sample of students from the University of Jordan. The pilot test aimed to assess the reliability and internal consistency of the instrument, as well as its usability and comprehensibility. Participants in the pilot test were asked to provide feedback on the clarity of the questions, the ease of completing the survey, and any technical issues encountered.

The results of the pilot test were analyzed to identify any problematic items or areas that required further revision.

Based on the feedback and data obtained from the pilot test, the final version of the questionnaire was developed. This version incorporated adjustments to improve item clarity, reduce ambiguity, and enhance the overall flow of the survey. The final questionnaire consisted of multiple sections, each designed to capture specific aspects of the students' e-learning experience.

4.2   Structure of the questionnaire

The questionnaire deployed in this study is bifurcated into two main sections. The initial section is designed to collect demographic data from the participants. This includes basic information such as age, gender, academic standing, and major areas of study, which are critical for contextualizing the subsequent responses within the appropriate demographic segments.

The second section of the questionnaire is more extensive and multifaceted. It aims to gauge students' knowledge and proficiency in utilizing e-learning platforms such as Moodle, Microsoft Teams, and Zoom. Additionally, it probes into the factors that influence students' comprehension and utilization of these platforms in educational contexts. Key aspects under evaluation include the perceived efficacy of these e-learning platforms in facilitating the educational process, issues encountered by students in using e-learning, the scope of disciplines engaging with e-learning methodologies, and the duration dedicated to e-learning endeavors by the students.

Moreover, this section solicits information on the types of activities or tasks that participants typically perform within the e-learning environment. It also seeks students' perspectives on the integration of e-courses in the learning process. Finally, the survey examines the impact of e-learning on students' self-study habits and

motivational levels. The aim is to derive a nuanced understanding of the e-learning experience and its overarching influence on student engagement and academic motivation.

The final questionnaire included the following sections:

Demographic information: This section collected basic demographic information, including age, gender, academic level, and field of study.

E-learning platform usage: Questions in this section focused on the students' familiarity with and frequency of use of Moodle, Microsoft Teams, and Zoom.

Perceptions of e-learning platforms: This section included items measuring students' attitudes towards e-learning platforms, their perceived effectiveness, and the impact on their learning processes.

Self-directed learning: Items in this section assessed the extent to which e-learning platforms facilitated self-directed learning, including motivation, time management, and independent study skills.

Academic performance: This section contained questions related to the students' academic achievements and how they were influenced by the use of e-learning platforms.

Social and interpersonal relationships: Questions in this section explored the impact of e-learning on students' interactions with peers and instructors.

Challenges and preferences: This section included items that identified challenges faced by students when using e-learning platforms and their preferences for blended or traditional learning methods.

4.3 Data collection and analysis

The questionnaire was distributed online to a target sample of both graduate and undergraduate students at the University of Jordan. Pre-survey email notifications, invitations, and confirmations were sent to approximately 720 individuals, resulting in 450 completed responses, achieving a response rate of 62.5%. This sample provided a diverse and representative dataset for analysis.

Descriptive statistics were used to summarize the demographic characteristics of the participants and their responses to the questionnaire. Measures of central tendency (mean, median) and dispersion (standard deviation, range) were calculated for continuous variables, while frequencies and percentages were reported for categorical variables. These statistics provided a comprehensive overview of the sample, including age distribution, gender ratio, academic level, and familiarity with e-learning platforms.

Multiple regression analysis was employed to explore the relationships between students' attitudes towards e-learning (a dependent variable) and several independent variables, including gender, age, prior computing experience, digital technology attitudes, and learning preferences. This method allowed us to identify significant predictors and quantify their impact on student engagement and academic performance. The regression model was evaluated for goodness of fit using R-squared values, and the significance of individual predictors was assessed using t-tests and p-values.

The results of the data analysis were presented in a series of tables to enhance clarity and facilitate interpretation. Descriptive statistics were summarized in tabular form, showing the distribution of key variables. The outcomes of the multiple regression analysis were presented in a regression table, indicating the coefficients, standard errors, t-values, and p-values for each predictor. Factor loadings from the factor analysis were displayed in a table, showing the items associated with each extracted factor.

To ensure transparency and reproducibility, the statistical methods and software used for analysis were clearly documented. All analyses were conducted using the latest version of statistical software (SPSS), and the assumptions underlying each statistical test were checked and reported.

4.4 The participants

The demographic characteristics of the participants are outlined in Table 1. The data reveals a nearly even distribution by gender, with females comprising 53% of the sample and males 47%. The student population was bifurcated into undergraduate and graduate segments across various disciplines. The online questionnaire was designed to ensure random sampling, providing an equal opportunity for all societal members to be selected for participation. From the pool of 30,000 graduates, a representative quota sample of 250 students was meticulously determined for inclusion in the study.

Table 1. Participant characteristics

Characteristic	Category	Percentage
Gender	Male	47%
	Female	53%
Student Rank	4th Year	26%
	3rd Year	23%
	2nd Year	25%
	1st Year	26%
Major	Scientific	56%
	Humanities	44%
Prior awareness of E-learning Platforms	Yes	91%
(Moodle, Microsoft teams and Zoom)	No	9%
Prior experience completing an E-learning course	Yes	83%
Prior experience completing a webbased	Yes	43%
course at another platforms	No	57%

5 DATA COLLECTION

Data for this study were amassed through a meticulously structured Google Forms questionnaire. Guidance on completing the questionnaire was provided to ensure clarity and consistency among responses. A randomized sampling technique was employed to distribute 250 questionnaires among graduate and undergraduate students. The completion rate was notably high, with all questionnaires being returned and subsequently analyzed using Google Forms' analytic capabilities and SPSS software.

The feasibility of the questionnaire was largely due to its succinct nature, which allowed for rapid completion while still being comprehensive enough to gather relevant data. Respondents were able to submit their answers with ease online, which

streamlined the process considerably. The selection of the questionnaire items was strategic, designed to enable robust statistical analysis. SPSS software was the tool of choice for data analysis, facilitating thorough consistency analyses and regression analyses. The reliability of the questionnaire was quantified using the Cronbach alpha coefficient, with a threshold of 0.7 set for acceptable consistency levels. The scores obtained for all the Cronbach alpha coefficients surpassed the 0.7 mark, suggesting that the study's instruments were both reliable and of a reasonable quality range—70% being acceptable and above 80% considered excellent, in line with the standards set forth by Sekaran (2003).

Descriptive statistics were utilized to provide foundational insights into the data's characteristics. Metrics such as frequency distributions, mean values, standard deviations, and simple linear regression tests constituted the core descriptive statistics used for data analysis and model construction.

6   RESULTS

The data analysis yields unequivocal evidence regarding the participants' awareness and utilization of Moodle, Microsoft Teams, and Zoom platforms within the university's educational framework. An extensive majority of students have engaged with the various components of these e-learning platforms, indicating a high level of integration into their academic activities.

Detailed in Table 1 are the metrics related to students' comprehension of the application of these platforms and their judgments on the effectiveness of such tools in the realm of education. The findings suggest a strong consensus among the student body on the necessity of e-learning, both presently and in the future, and its burgeoning role in forging advanced educational models, facilitating enhanced interaction, and leveraging information technology, with a remarkable 97% in agreement.

Nevertheless, in juxtaposition to the optimistic outlook on e-learning, approximately 67.3% of those surveyed expressed reservations regarding the exclusive reliance on Moodle, Microsoft Teams, and Zoom platforms for full-time educational engagement. A minuscule fraction, less than 1%, harbored negative perceptions about the incorporation of these platforms in university education.

The results further illuminate that an overwhelming majority of participants, at 98%, are amenable to the idea of engaging in online courses, indicating a readiness to embrace or continue with this mode of learning. This underscores the potential for e-learning platforms to further permeate educational practices, marking a significant shift in the way knowledge is disseminated and acquired in higher education settings.

The results of the study provide substantial evidence that a predominant percentage of participants, specifically 89.7%, acknowledge the efficacy of Moodle, Microsoft Teams, and Zoom platforms in facilitating the utilization of modern teaching methodologies and the subsequent enhancement of ICT skills, with 88.1% of participants affirming this enhancement. These e-learning tools align with current communication models, enjoying a favorable reception, as evidenced by an 88.1% agreement rate among the respondents. Additionally, the platforms are credited with enabling further educational advancements, with 83.8% of the participants recognizing this benefit.

The study further illuminates a near unanimous willingness to engage with the courses provided through these platforms, with an impressive 92.2% of participants expressing their readiness to be trained. Notwithstanding this readiness,

a significant proportion of participants, accounting for 65.1%, perceive the adoption of these e-learning tools as an additional workload. The necessity and pertinence of e-learning in the context of both present and future educational frameworks are affirmed by 81.2% of the respondents. This perspective is bolstered by the majority's viewpoint that e-learning is germane to their specific field of study and facilitates a more efficient orchestration of the learning process.

A divergence in preference emerges regarding the full-time integration of e-learning, with 71.3% of participants harboring reservations. Conversely, an overwhelming 86.4% majority endorses a hybrid educational model, melding traditional pedagogical approaches with e-learning solutions. The positive influence exerted by these platforms on the facilitation of learner-teacher interactions is corroborated by 80.7% of participants, and the time efficiency and utility provided by such technological interventions are valued by 84.2%. Despite the wide acceptance of e-learning platforms as appropriate for a range of subjects, as agreed upon by 65.7% of participants, there remains a consistent belief in their universal suitability.

Table 2. Awareness of students towards the use of elements of Moodle, Microsoft Teams, and Zoom platforms in the teaching process (expressed as percentages)

Statement	Yes	No
Moodle, Microsoft Teams, and Zoom platforms aid in accessing additional educational material	82.8%	17.7%
Enhanced educational process through Moodle, Microsoft Teams, and Zoom by improving communication between the teacher and the student	80.7%	19.3%
Valuing the use of the electronic course as a significant investment of time and resources	84.2%	15.8%
Alignment of Moodle, Microsoft Teams, and Zoom course quality with contemporary educational standards	90.2%	9.8%
Potential of Moodle, Microsoft Teams, and Zoom platforms to substitute traditional labs and practical sessions with extensive practice and lectures	82.2%	17.8%
Inconvenience of the E-learning platform in the university setting	72.3%	27.7%
Applicability of E-learning across all subjects	71.3%	28.7%
Correspondence of the knowledge quantity and quality to the time invested in E-learning	90.5%	9.5%
Provision of continuous access to teaching materials and assignments via Moodle, Microsoft Teams, and Zoom platforms	92.3%	7.7%
Future prospects and the necessity of E-learning integration in the educational process	84.4%	15.6%
Relevance and suitability of E-learning to the current field of study	88.6%	11.4%
Enhanced organization of the learning process through E-learning	81.4%	18.6%
Facilitation of modern teaching resource utilization via E-learning	89.7%	10.3%
Improvement of ICT competencies through E-learning participation	88.1%	11.9%
Adherence to modern communication models and workflows with E-learning	83.1%	16.9%
Willingness to receive training in Moodle, Microsoft Teams, and Zoom platforms	83.1%	7.8%
Preference for using Moodle, Microsoft Teams, and Zoom elements in a fulltime educational format	71.3%	28.7%
Partial preference for integrating Moodle, Microsoft Teams, and Zoom elements with traditional educational methods	86.4%	13.6%

The offerings of these e-learning platforms are perceived to be on par with the educational standards of the day by 84.2% of respondents, though only a minority of 61.5% consider them a viable alternative to more tactile, laboratory-centric learning experiences. The university's e-learning system presents challenges for 72.3% of the participants, indicating areas for potential enhancement. Nevertheless, a strong correlation between the acquired knowledge through e-learning and the invested time is acknowledged by 84.2% of the respondents, suggesting an effective educational transaction.

The findings underscore a pronounced proclivity towards e-learning and signal the imperative for its strategic integration into existing educational practices. The discussion accentuates the high valuation of e-learning platforms for their capacity to modernize and make the educational process more efficient. Yet, it simultaneously indicates a clear preference for a balanced approach, one that harmonizes these platforms with conventional, interactive, and practical learning experiences.

Table 3 presents compelling insights into the efficacy of e-learning platforms such as Moodle, Microsoft Teams, and Zoom on the learning process of students. An impressive 81.1% of participants confirmed that these platforms enhance the speed of learning.

Table 3. Perceptions of e-learning effectiveness among students using Moodle, Microsoft Teams, and Zoom platforms

Statements	Agree (%)	Disagree (%)
The use of Moodle, Microsoft Teams, and Zoom platforms accelerates the pace of my learning	82.5	17.5
Engaging with Moodle, Microsoft Teams, and Zoom enhances my learning experience	82.6	17.4
The autonomy provided by studying online offers me a sense of relief	83.2	16.8
My preference for working independently online without external assistance is strong	85.5	14.5
Online exams conducted through these platforms present no significant difficulties	84.6	15.4
My interpersonal relationships benefit from the positive impact of E-learning	82.8	17.2
Through Moodle, Microsoft Teams, and Zoom, I am able to comprehend course content more effectively	86.4	13.6
These E-learning platforms have enhanced my time management skills during study periods	87.0	13.0
My capability to complete homework independently, utilizing online resources, has improved	79.7	20.3
Motivation levels for studying have increased due to E-learning with these platforms	88.8	11.2
Self-directed learning using Moodle, Microsoft Teams, and Zoom has enhanced my self-efficacy in achieving personal academic goals	82.6	17.4
Studying through these platforms has strengthened my retention and recall of the material	81.7	18.3
The enjoyment of learning is significantly heightened by using Moodle, Microsoft Teams, and Zoom for E-learning	86.6	13.4
The adoption of these E-learning tools has made the educational process more engaging	84.5	15.5
My willingness to embrace challenges has been fostered by the use of Moodle, Microsoft Teams, and Zoom	79.5	20.5

Indicating a substantial improvement in the efficiency of knowledge acquisition. Furthermore, a notable 82.6% of the students reported a marked improvement in their retention of information when engaged in online training via these platforms.

The sentiment of autonomy in learning resonates strongly among the participants, with 83.2% expressing a sense of relief at the opportunity to learn independently online. This mode of self-directed learning is perceived as less daunting, as evidenced by 84.6% of students who did not find it challenging to respond to the demands of online learning environments, a viewpoint supported by 85.5% who consider it manageable without the need for external assistance.

The findings further reveal that the majority of learners are capable of understanding the lessons provided through these e-learning programs, thereby bolstering their ability to manage their study time effectively. In an affirmation of the motivational impact of these platforms, a substantial 88.8% of learners have observed an enhancement in their study motivation. Additionally, the ability to self-study has been positively influenced, with 82.6% of students adapting their study skills to the demands of online learning. Not only has self-study led to a better grasp of the material, as indicated by 82.7% of students, but it has also rendered the process of learning significantly more enjoyable for 86.6% of the respondents. The analysis also suggests that the majority of participants are confident in their ability to retain more information when studying online with these platforms, underscoring the value of independence in the learning process. Moreover, Table 3 sheds light on personal learning preferences, with 79.5% of participants finding that the use of Moodle, Microsoft Teams, and Zoom platforms aligns well with their individual needs, thereby illustrating the platforms' versatility and user-centric approach.

7 DISCUSSION

The primary aim of this study was to explore students' perspectives on the efficacy of e-learning via Moodle, Microsoft Teams, and Zoom platforms and its implications for self-directed learning and academic achievement. An analysis of the data leads us to assert that these e-learning platforms are regarded as pivotal to the educational experience. The majority of students hold the belief that such tools are not only crucial for contemporary education but will continue to play an integral role in the learning process going forward. These platforms serve as catalyst for educational activities, enabling students to manage their learning more efficiently and leveraging traditional resources as part of a holistic learning strategy, akin to the findings of Adewole (2014).

Our study suggests that e-learning platforms align well with current models of communication and information dissemination. This is corroborated by Goosse et al. (2023), who reported enhancements in communication skills among psychology students through hybrid CMT programs that included e-learning modules [22]. Despite this, a segment of participants expressed a preference for part-time or blended learning approaches over full-time e-learning, indicating a desire for flexibility in learning modalities.

Further examination of our results reveals a readiness among most students to engage with additional educational content delivered through e-learning platforms. This echoes the findings of Cheng et al. (2024), who found that case-based teaching videos on e-learning platforms positively impacted students' self-regulated learning outcomes, enhancing both motivation and academic performance [24]. Additionally, the enhanced interaction between teachers and students facilitated by e-learning

platforms has been reinforced in the current educational milieu, as demonstrated by the recent adoption of such methods in Jordan [17].

E-learning has extended its reach, proving to be a powerful tool for ICT skill development, as students with higher levels of ICT proficiency are more likely to utilize and benefit from these platforms [24]. The integration of Moodle, Microsoft Teams, and Zoom platforms in the educational landscape has revolutionized the way students interact with learning material, peers, and instructors. These platforms have not only facilitated a more self-directed learning approach but also provided a flexible framework that caters to the diverse needs of the student body, ultimately contributing to a more dynamic and inclusive educational environment.

This study set out to explore student perceptions of the efficacy of Moodle, Microsoft Teams, and Zoom platforms in e-learning environments, particularly their impact on self-directed learning and academic achievement. The results have affirmed that the curriculum delivered through these platforms is reflective of modern educational standards and is versatile across a variety of subjects. An intriguing aspect of our findings is the positive influence that e-learning has on personal relationships, making learning an enjoyable experience. This aligns with Kong et al.'s (2021) study, which found that e-learning-based exploratory education significantly affects students' self-efficacy and interpersonal relationships, thereby fostering a supportive learning environment [13].

Participants from the University of Jordan highlighted the user-friendly nature of these platforms, which facilitate around-the-clock access to learning materials and support. This ubiquity of resources is instrumental in fostering students' ability to conduct self-study, promoting advancements at a pace suited to individual capabilities—a point that resonates with the insights from Nurfitriyani and Legowo (2023), where student satisfaction with Zoom as an e-learning tool was notably influenced by the quality of interaction and perceived usefulness [23].

Moreover, the platforms' contribution to developing time management skills and intrinsic motivation to learn echoes the findings of Cheng et al. (2024), who found that case-based e-learning videos improved learners' self-regulation and academic performance [24]. An intriguing aspect of our findings is the positive influence that e-learning has on personal relationships, making learning an enjoyable experience. An intriguing aspect of our findings is the positive influence that e-learning has on personal relationships, making learning an enjoyable experience. This aligns with Kong et al.'s (2021) study, which found that e-learning-based exploratory education significantly affects students' self-efficacy and interpersonal relationships, thereby fostering a supportive learning environment [13]. Nevertheless, the results suggest that while students appreciate the independence afforded by e-learning, there is a notable reluctance to collaborate with peers in this setting, suggesting a preference for solitary study that maximizes the individual learning experience prior to formal assessments. This highlights a potential area for further exploration, as cooperative learning has been known to enrich educational experiences. The studies underscores the multifaceted benefits of Moodle, Microsoft Teams, and Zoom platforms in fostering a more engaging, accessible, and personalized learning environment. Despite the challenges, the positive reception of e-learning platforms among students signifies a transformation in the pedagogical landscape, one that harmonizes educational objectives with the digital prowess and preferences of the learner demographic.

8   FINDINGS AND CONCLUSIONS

The study reveals that a significant majority of students recognize the value of e-learning platforms in enhancing their educational experience. According to the

data, these platforms are integral to modern education, facilitating access to additional educational materials, improving communication between teachers and students, and supporting a more organized and flexible learning process. This indicates that e-learning platforms are crucial for contemporary education and will continue to play an essential role in the future. In terms of student engagement and self-directed learning, the findings indicate that e-learning platforms have a positive impact. An overwhelming majority of students reported increased motivation and the ability to manage their study time more effectively. The autonomy provided by these platforms allows students to learn at their own pace, enhancing their ability to retain information and perform academically. This underscores the platforms' role in promoting self-directed learning and academic achievement.

The study highlights a high level of readiness and acceptance among students to engage with e-learning tools. The majority of participants expressed their willingness to continue using these platforms for their studies, indicating a strong endorsement of their benefits. This readiness underscores the potential for e-learning platforms to become even more integrated into educational practices. While students appreciate the benefits of e-learning, the findings also show some reservations about relying exclusively on digital platforms for education. Approximately 67.3% of students expressed a preference for part-time or blended learning approaches over full-time e-learning. This suggests a need for educational institutions to adopt flexible learning models that cater to diverse student preferences, combining traditional and digital methods to provide a balanced educational experience.

The data suggests that e-learning platforms significantly enhance students' ICT skills and academic performance. Students with higher levels of ICT proficiency are more likely to utilize and benefit from these platforms. This finding indicates that prior experience with digital tools can positively influence learning outcomes, highlighting the importance of integrating ICT training into the curriculum. The study finds that e-learning platforms also have a positive impact on students' interpersonal relationships and self-efficacy. The platforms facilitate better communication and interaction among students and between students and teachers, contributing to a supportive learning environment. This aligns with previous study, indicating that e-learning can foster a sense of community and enhance the overall educational experience.

9   RECOMMENDATIONS

Based on the findings of this study, several recommendations can be made to enhance the effectiveness of e-learning platforms and their integration into higher education. These recommendations are directed towards educators, policymakers, and studied.

Firstly, educators and policymakers should consider adopting a blended learning approach that combines traditional and digital methods. This approach caters to diverse student preferences and provides a balanced educational experience. Institutions should invest in ICT training programs to enhance students' digital literacy, ensuring that they can fully utilize e-learning platforms to their advantage. Additionally, continuous professional development for educators is crucial to keeping them updated with the latest e-learning tools and methodologies. Creating a supportive and engaging online learning environment is essential. Institutions should focus on improving the interactivity and usability of e-learning platforms, incorporating features that facilitate communication and collaboration among students and between students and instructors. Providing access to high-quality digital resources

and ensuring the platforms are accessible around the clock can significantly enhance students' learning experiences and outcomes.

Secondly, studied should continue to explore the impact of e-learning platforms on various aspects of education, extending beyond academic performance to include factors such as student wellbeing, motivation, and engagement. Future studies should investigate the long-term effects of e-learning and the sustainability of its benefits over time. Researchers can also explore the differential impacts of e-learning platforms across diverse student demographics, such as age, gender, and field of study, to identify specific needs and tailor interventions accordingly. It is recommended that studied employ a mixed-methods approach in future studies, combining quantitative data with qualitative insights to provide a comprehensive understanding of the e-learning experience. Longitudinal studies can offer valuable insights into how students' perceptions and effectiveness of e-learning platforms evolve over time. Additionally, comparative studies between different e-learning platforms can identify best practices and highlight the most effective features for enhancing student engagement and learning outcomes. Researchers should also focus on developing and testing innovative e-learning tools and pedagogical models that leverage emerging technologies, such as AI and VI, to create more immersive and personalized learning experiences. Collaboration between study, educators, and technology developers is essential to ensuring that new e-learning solutions are practical, user-friendly, and aligned with educational objectives.

10   REFERENCES

[1] A. H. Galvis and D. Carvajal, "Learning from success stories when using elearning and blearning modalities in higher education: A meta-analysis and lessons towards digital educational transformation," *International Journal of Educational Technology in Higher Education*, vol. 19, no. 23, 2022. https://doi.org/10.1186/s41239-022-00325-x

[2] R. Raja and P. Nagasubramani, "Impact of modern technology in education," *Journal of Applied and Advanced Research*, vol. 3, no. 1, 2018. https://doi.org/10.21839/jaar.2018.v3iS1.165

[3] T. P. Ngoc and L. T. K. Phung, "Online language learning via moodle and microsoft teams: Students' challenges and suggestions for improvement," in *Proceedings of the 17th International Conference of the Asia Association of Computer-Assisted Language Learning (AsiaCALL 2021)*, 2021, pp. 106–113. https://doi.org/10.2991/assehr.k.210226.013

[4] C. Dede, "The evolution of distance education: Emerging technologies and distributed learning," *American Journal of Distance Education*, vol. 10, no. 2, pp. 4–36, 1996. https://doi.org/10.1080/08923649609526919

[5] Lori Arp, Beth S. Woodard, and L. Mestre, "Accommodating diverse learning styles in an online environment," *Reference and User Services Association*, vol. 46, no. 2, pp. 27–32, 2006. https://doi.org/10.5860/rusq.46n2.27

[6] H. W. Asrini, G. W. Wicaksono, B. Budiono, G. Ramadhan, and E. D. Wahyuni, "Recommended features of learning management system using feature-oriented method software development on moodle," *Kinetik: Game Technology, Information System, Computer Network, Computing, Electronics, and Control*, vol. 6, no. 4, 2021. https://doi.org/10.22219/kinetik.v6i4.1354

[7] A. Al-Adwan and J. Smedley, "Implementing e-learning in the Jordanian higher education system: Factors affecting impact," *International Journal of Education and Development using ICT*, vol. 8, no. 1, 2012.

[8] S. Baars, G. L. Schellings, S. Krishnamurthy, J. Joore, P. J. Brok, and P. J. Wese-mael, "A framework for exploration of relationship between the psychosocial and physical learning environment," *Learning Environments Research*, vol. 24, pp. 43–69, 2021. https://doi.org/10.1007/s10984-020-09317-y

[9] H. C. Triandis, R. S. Malpass, and A. R. Davidson, "Cross-cultural psychology," *Bien-Nial Review of Anthropology*, vol. 7, pp. 1–84, 1971.

[10] G. Conole and M. Oliver Eds., "Contemporary perspectives in e-learning research," *Method and Impact on Practice (1st ed.)*, Routldge, 2006. https://doi.org/10.4324/9780203966266

[11] M. Sekine *et al.*, "Effects of COVID-19 on Japanese medical students' knowledge and atti-tudes toward elearning in relation to performance on achievement tests," *PLoS ONE*, vol. 17, no. 3, p. e0265356, 2022. https://doi.org/10.1371/journal.pone.0265356

[12] Kaharuddin, "E-Learning during the COVID-19 outbreak: The effect of the grammar translation method and the direct method on students' English competence," *Journal of Language Teaching and Research*, vol. 13, no. 2, pp. 271–278, 2022. https://doi.org/10.17507/jltr.1302.06

[13] L. Kong, Z. Chu, and Y. Li, "A study of effects of e-learning based exploratory education on students' self-efficacy and interpersonal relationship," *Revista de Cercetare si Interventie Sociala*, vol. 72, pp. 33–43, 2021. https://doi.org/10.33788/rcis.72.2

[14] R. Aissi and S. Mouas, "Analyzing teachers' perceptions of the impact of moodle per-sonalized positive feedback on foreign language students' motivation and engage-ment," *European Scientific Language Jounal*, pp. 123–141, 2024. https://doi.org/10.18355/XL.2024.17.01.09

[15] H. A. El-Sabagh, "Adaptive e-learning environment based on learning styles and its impact on development students' engagement," *Int. J. Educ. Technol. High. Educ*, vol. 18, 2021. https://doi.org/10.1186/s41239-021-00289-4

[16] Yustina, I. Mahadi, D. Ariska, Arnentis, and Darmadi, "The effect of e-learning based on the problem-based learning model on students' creative thinking skills during the COVID-19 pandemic," *International Journal of Instruction*, vol. 15, no. 2, pp. 329–348, 2022. https://doi.org/10.29333/iji.2022.15219a

[17] A. R. Alsoud and A. A. Harasis, "The impact of COVID-19 pandemic on student's e-learning experience in Jordan," *J. Theor. Appl. Electron. Commer. Res*, vol. 16, no. 5, pp. 1404–1414, 2021. https://doi.org/10.3390/jtaer16050079

[18] O. Sulaymani, A. R. Pratama, M. Alshaikh, and A. Alammary, "The effects of previous experience and self efficacy on the acceptance of e-learning platforms among younger students in Saudi Arabia," *Contemporary Educational Technology*, vol. 14, no. 2, p. ep349, 2022. https://doi.org/10.30935/cedtech/11524

[19] S. Karimi, M. Derakhshan, F. Jabinian, and A. Tondro, "Investigating the effect of e-learning with a blended approach on the rate of learning in nursing students during COVID-19 pandemic," *Journal of Medicinal and Chemical Sciences*, vol. 6, no. 11, pp. 2620–2627, 2023.

[20] S. H. Kim and S. Park, "Influence of learning flow and distance e-learning satisfaction on learning outcomes and the moderated mediation effect of social-evaluative anxiety in nursing college students during the COVID-19 pandemic: A cross-sectional study," *Nurse Education in Practice*, vol. 56, p. 103197, 2021. https://doi.org/10.1016/j.nepr.2021.103197

[21] X. Zhao, J. Wang, M. Wang, X. Li, X. Gao, and C. Huang, "A new model for assessing the impact of environmental psychology, e-learning, learning style and school design on the behavior of elementary students," *Kybernetes*, vol. 50, no. 2, pp. 512–527, 2021. https://doi.org/10.1108/K-09-2019-0579

[22] M. Goosse, F. Kreusch, H. T. Molen, and S. Willems, "Impact of e-learning and role play-based training on psychology students' communication skills: A feasibility study," *Journal of Communication in Healthcare*, vol. 16, no. 3, pp. 287–297, 2023. https://doi.org/10.1080/17538068.2023.2193493

[23] S. J. Nurfitriyani and N. Legowo, "Factors affecting students' perceived impact on learning and satisfaction with Zoom at University in DKI Jakarta, Indonesia," *Journal of System and Management Science*, vol. 13, no. 4, pp. 469–487, 2023. https://doi.org/10.33168/JSMS.2023.0428

[24] S.-F. Cheng, C.-W. Cheng, C.-Y. Hung, and P.-H. Chang, "Effect of case-based teaching videos on e-learning platforms on the self-regulated learning outcomes of students," *Social Work Education*, pp. 1–21, 2024. https://doi.org/10.1080/02615479.2024.2310586

[25] P. Peters *et al.*, "Effect of head-mounted displays on students' acquisition of surgical suturing techniques compared to an e-learning and tutorled course: A randomized controlled trial," *Internaltional Journal of Surgery*, vol. 109, no. 8, pp. 2228–2240, 2023. https://doi.org/10.1097/JS9.0000000000000464

[26] T. F. A. Qushtom, O. M. K. Ballout, A. S. M. Harb, and O. F. Shaqqour, "The impact of e-learning system adoption on the practical skills of accounting students in Jordan," *Humanities and Social Science Letters*, vol. 11, no. 3, pp. 312–321, 2023. https://doi.org/10.18488/73.v11i3.3496

[27] M. S. Alabdulaziz, "The effect of using PDEODE teaching strategy supported by the e-learning environment in teaching mathematics for developing the conceptual understanding and problem-solving skills among primary stage students," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 18, no. 5, Art. no. em2109, 2022. https://doi.org/10.29333/ejmste/12019

[28] P. Dangaiso, F. Makudza, D. C. Jaravaza, J. Kusvabadika, N. Makiwa, and C. Gwatinyanya, "Evaluating the impact of quality antecedents on university students' e-learning continuance intentions: A post COVID-19 perspective," *Cogent Education*, vol. 10, no. 1, 2023. https://doi.org/10.1080/2331186X.2023.2222654

[29] A. H. A. Rahman, M. N. Yaacob, N. S. A. Samad, S. R. Mohamad, and N. A. A. Sabri, "Post-COVID-19 e-learning acceptance and its impact on community college students in kelantan, Malaysia: A quantitative analysis," *Internaitional Journal of Innovative Research and Scientific Studies*, vol. 6, no. 2, pp. 366–373, 2023. https://doi.org/10.53894/ijirss.v6i2.1446

[30] A. E. E. Sobaih, A. Hasanein, and I. A. Elshaer, "Higher education in and after COVOD-19: The impact of using social network applications for e-learning on students' academic performance," *Sustainability*, vol. 14, no. 9, p. 5195, 2022. https://doi.org/10.3390/su14095195

[31] C. W. Ching and N. Maarof, "Effect of student satisfaction on elearning quality and learning outcome among Malaysian undergraduate nursing students," *Ching, Lumpur and Maarof*, vol. 18, no. 3, 2021. https://doi.org/10.9743/JEO.2021.18.3.2

[32] E. A. Ali Krishan, A. H. I. Almsaiden, E. N. Al Njadat, and A. A. Abohelalah, "The impact of e-learning on the learning motivation of Jordanian university students," *Journal of Educational and Social Research*, vol. 13, no. 5, p. 313, 2023. https://doi.org/10.36941/jesr-2023-0139

[33] A. K. Al Hwaitat *et al.*, "Overview of mobile attack detection and prevention techniques using machine learning," *International Journal of Interactive Mobile Technologies*, vol. 18, no. 10, pp. 125–157, 2024. https://doi.org/10.3991/ijim.v18i10.46485

[34] H. N. Fakhouri *et al.*, "Improved path testing using multi-verse optimization algorithm and the integration of test path distance," *International Journal of Interactive Mobile Technologies*, vol. 17, no. 20, pp. 38–59, 2023. https://doi.org/10.3991/ijim.v17i20.37517

[35] N. Nsairat, H. N. Fakhouri, R. O. Alsawalqa, and F. Hamad, "Music students' perception towards music distance learning education during COVID-19 pandemic: Cross-sectional study in Jordan," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 16, no. 6, pp. 135–158, 2022. https://doi.org/10.3991/ijim.v16i06.27193

[36] F. Hamad, M. Elfadel, H. Fakhouri, and A. Abu-Qaadan, "Advancing climate change literacy: Are academic libraries part of the solution?" *New Review of Academic Librarianship*, pp. 1–23, 2024. https://doi.org/10.1080/13614533.2024.2369503

[37] F. Hamad, M. Al-Fadel, and H. Fakhouri, "The provision of smart service at academic libraries and associated challenges," *Journal of Librarianship and Information Science*, vol. 55, no. 4, pp. 960–971, 2023. https://doi.org/10.1177/09610006221114173

[38] F. Hamad, M. Al-Fadel, and H. Fakhouri, "The role of academic libraries and information specialists during times of health crises in Jordan: The COVID-19 pandemic case," *Digital Library Perspectives*, vol. 38, no. 4, pp. 476–492, 2022. https://doi.org/10.1108/DLP-02-2021-0009

11   AUTHORS

Zaid Khrisat is with the Faculty of Arts and Educational Sciences, Middle East University, Amman, Jordan (E-mail: zkhrisat@mau.edu.jo).

Hussam N. Fakhouri is with the Data Science and Artificial Intelligence Department, University of Petra, Amman, Jordan (E-mail: Hussam.fakhouri@uop.edu.jo).