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The use of digital learning units in secondary schools in Hail: Teachers' perspectives

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ABSTRACT

This study aimed to investigate the use of digital learning units in secondary school teaching, focusing on the experiences of teachers in Hail City. A descriptive research design was used, with data collected through a self-developed questionnaire. The sample included 250 secondary school teachers. The results showed strong support for digital learning units, with average scores of 2.89, 2.89, and 2.90 across three measured areas. Overall, the average score of approximately 2.89 suggests that the use of digital learning units was viewed positively. Statistical analysis revealed significant differences in teachers' responses based on age, while no significant differences were found based on social status, education level, or teaching experience. The findings highlight the importance of improving teacher training programs to overcome challenges in technology integration. The study recommends further research to determine how long it takes for digital learning units to affect student achievement and to assess the impact of professional development for teachers who frequently use digital technology in their teaching. Future studies should also examine the long-term effects of digital learning across different subjects, its influence on student performance, and the role of emerging technologies such as artificial intelligence and virtual reality in shaping educational outcomes.

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1. Introduction

The development of digital learning units has vastly strengthened the relationship between education and the quality of life (QOL). The reduction of the costs of educational services is a major factor in improving living standards. Since the advent of digital technology, there has been an increased effort by educational institutions to promote digital education as a means of offering students a different choice from the traditional education methods. Policies to increase market opportunities in digital learning are adopted by governments (Ramaditya et al., 2023). Crompton and Burke (2018) affirmed that mobile technology has become a transformative force in education, enabling direct access to learning through highly interactive and engaging multimedia content. Their systematic review revealed that mobile learning supports personalized, flexible, and student-centered experiences, significantly enhancing learner engagement and educational outcomes across disciplines. However, schools and educational institutions have found ways to integrate teaching and learning processes through technology-supported learning tools like mobile devices, smart boards, online courses, tablets, laptops, simulations, dynamic visuals, and virtual labs (Keengwe and Bhargava, 2014). These tools have allowed shared knowledge to be disseminated to a broader population, thereby driving comprehensive educational reforms in geographical areas. These technologies have taken prevalence and have since been integrated within the educational landscape of the world by educational institutions worldwide.

The integration of technology has generated different ways to deliver knowledge and is driving continued educational reform. This change in acceptance of technology-based tools, such as mobile devices, smartboards, online courses, tablets, laptops, simulations, dynamic visuals, and virtual labs within traditional educational programs is a huge transformation. Valencia-Arias et al. (2024) emphasized that the adoption of mobile learning

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approaches (MLA) in higher education has significantly advanced through the integration of convergent technologies, offering learners flexible and innovative educational opportunities. For these competencies to be effectively realized in such a transformative context, a comprehensive framework is required. This includes the systematic development of high-quality digital content, strategic planning for content creation, careful design and execution of instructional scenarios, robust assessment mechanisms, efficient digital implementation strategies, and strict quality control measures addressing both academic rigor and technological functionality.

Elrefaie (2019) stated that using the methods of the cognitive apprenticeship model in adaptive e-learning environments proves more successful than traditional methods in the development of the skills required to produce digital content. Furthermore, besides learning units on digital forms, they will be integrated into the educational pedagogy in an interdependent and logically consistent manner, thus enhancing the intelligent coherence between subject matter elements, which will lead to an increase in the learning profile of the student.

Literature has made it apparent that digital learning tools contribute substantially to overall educational quality and accessibility. While this research is promising, there still remains a significant chasm of research in terms of how to embed these technologies in education in ways that continue to prove beneficial in the long term in a diversity of educational contexts. Importantly, very few studies have examined the combined effects of different technological tools, such as mobile devices, smartboards, and virtual labs, on educational outcomes. While the technologies are largely in place, very little thought has been given to incorporating these technologies into curricula in an educationally sound and scalable fashion across educational levels. Nevertheless, more exploration is needed in these underexplored areas to find more insights on how to make learning more optimal towards the varied learner populations in the context of technologically enhanced learning.

Thus, the adoption of information technologies has changed education and introduced programmable inventions that can be used to facilitate teaching and learning, such as DLUs. DLUs offer educators pre-built multimedia and simulation content, as well as virtual labs, in order to deliver an engaging learning experience. More specifically, DLUs are responsible for modernizing learning practices within the progression of the education systems to enhance student outcomes as identified by Timotheou et al. (2023). However, several difficulties are present, which hinder the successful implementation of DLUs. Challenges affecting the implementation of new practices have the greatest impact on teachers through the following: changes in teaching practices and methods. At the school level, barriers take the physical form of structures and the informational form of technologies. They include the scarcity of training programs and the few materials that are available for use in teaching and learning science and/or other subjects. Such things point to the lack of systematic measures toward the integration of DLUs into the secondary education system (Nilsen et al., 2020).

However, there are a number of challenges that exist, which create problems in the effective functioning of DLUs. Challenges affecting the implementation of new practices have the greatest impact on teachers through the following: Educational paradigms shift of teaching strategies, and approaches. In the context of the school level, barriers assume the structural guise and the informational guise as technologies. Some of these are the lack of training programs and the few copies of material that are available for teaching and learning science and/or any other subject. Such a thing depicts the absence of systematic effort towards the integration of the DLUs into the system of secondary education.

Pursuant to the modern world's push towards the promotion of efforts towards a digital shift in education, there has been a call for more focus on the DLUs. Both the formulators of policies and academics understand the need to provide teachers with the ability, both in terms of skills and in terms of training, for optimal use of technology, more so due to the effect of COVID-19. It also emerges that efforts to close research gaps in this area are important for the progress of integrating DLUs in secondary education (Nilsen et al., 2020).

The Internet (or technology in general) is an indispensable element in people's lives, personal as well as professional. Digital learning has made education and information more accessible and useful for students with the tools and attitudes necessary for success. However, research has already shown that adding technology to the learning process, for example, by giving students Internet access during class, helps produce better outcomes. According to Delgado et al. (2015), digital learning solutions provide actionable recommendations for educational purposes, and having a digital mindset will boost the learning experience. Technology-enhanced learning (TEL), or digital education in short, uses advanced technology for enhanced learning. These technologies enable teachers to deliver meaningful and engaging educational experiences in their classrooms, which may either augment or replace traditional online courses or learning programs (Singh and Thurman, 2019). This study addresses the following primary research question: How are digital learning units practically applied in teaching within educational institutions? This primary question is further explored through the following sub-questions:

1. How does the planning for the use of digital learning units in teaching take place as secondary school teachers in Hail experience them?
2. Secondary school teachers in Hail teach to what extent they use digital learning units?

3. What obstacles exist in using digital learning units in teaching, as perceived by secondary school teachers in Hail?
4. Are there statistically significant differences at the significance level (α=0.05) in the mean responses of secondary school teachers in the study sample based on variables such as age, marital status, educational level, and years of experience?

This study explores the current state of using digital learning units in teaching at the secondary school level in Hail through the following objectives:

1. Thus, the purpose of the study was to establish the level of planning for the use of the DLUs in teaching according to the secondary school teachers of Hail.
2. This study aims to analyze the extent of the integration of the teaching digital learning units with the perspectives of the secondary school teachers in Hail.
3. The objective of this study is to discover obstacles that prevent the effective use of digital learning units in teaching, according to secondary school teachers in Hail.
4. Examined the hypothesis testing of the difference in the mean response of the secondary school teachers with respect to demographic variables in the study sample.

Theoretical importance:

1. The findings of this research contribute to the development of the theoretical understanding of the integration of digital learning units into education in secondary schools in Hail and increase the existing body of knowledge.
2. Above all, it provides an understanding of how digital technology affects teaching practice with reference to planning, implementation, and different barriers to integration.
3. The research in this study fills a gap in the literature by focusing on the Turkish context while examining the effectiveness of digital learning units from the standpoint of teachers in secondary schools in Saudi Arabia.
4. This will provide an impetus for future studies into the correlation between tools used in digital learning and teaching outcomes, opening possibilities for investigation in other education stages as well as in other geographical areas.
5. This study contributes to the refinement of theoretical models of educational technology adoption, emphasizing its role in enhancing teaching methods and fostering student engagement.

Practical importance:

1. The results of this study can serve as actionable insights to help policymakers and administrators respond to difficulties that teachers experience while transforming themselves to using digital teaching material.
2. The importance of the development of infrastructure and resources for a successful integration of digital tools in classrooms is also highlighted in this paper.
3. It offers valuable guidance to the teaching staff on how digital units can enhance both teaching efficiency and student outcomes.
4. This study provides recommendations to the Ministry of Education regarding the development and implementation of digital learning tools, along with accompanying training programs.
5. This enlightens the professional development activities offered to teachers and pedagogical utilization of ICT to cater to lesson learning intentions and students' acquisition of knowledge.
6. Through this study, schools open a chance to incorporate both traditional and digital approaches to teaching, enabling the provision of a lively teaching environment.

Digital learning units: Digital learning is a subset of e-learning that is most similar to virtual learning. It is a technique based on an electronically arranged system within a cognitive digital system with an electric alphabet (0/1) and a structured learning curriculum delivering content through information media. It is also defined as an effective teaching-learning model with the use of technology and supporting technologies to engage students and teachers in real-time learning via the internet, thus improving teachers' technological literacy and use of technological integration. In addition, digital learning is perceived as an aspiration in learning techniques that brings out standard use of electronic devices in teaching practice, which makes it easier and more efficient to acquire knowledge, as identified by OECD (2021).

Digital learning units are defined as digital materials reused in education and learning, encompassing text, images, sound, still and moving graphics, and video clips. These units are short, typically ranging from 1 to 15 minutes in duration. They are a collection of educational materials organized according to specific pedagogical principles, which include objectives, desired outcomes, and assessment methods. Files in an educational context mean that the information and educational files can be in the form of text, PowerPoint presentations, audio, graphics, or other formats. Operational definition of digital learning units: For the purposes of this study, the researcher operationally defines a digital learning unit as being one or more units of digital media containing educational content in a reusable format to be delivered along one or more pathways or in other non-pathway-related applications. These units consist of all text, all images, all of how the images move, and all the sound and video that may be part of a learning unit that is itself designed to fit into a variety of learning contexts.

New methods in education: Digital education has thus reduced and revolutionized not only the process of learning and teaching but also the focus of content. Various approaches now meet the demands of teaching and learning, including virtual and augmented environments, libraries, and webinars, all of which have been enhanced by digital tools (Aristovnik, 2013). This approach has been widely implemented in colleges, universities, and corporate learning programs. Technology for distance learning has a central function of converting conventional course handouts to electronic formats and ensuring that sharing information, ideas, and experience is as effective as possible. In addition, delivering training through digital media is more flexible, tailored, and has higher coverage than traditional training.

Types of digital learning units: There are a variety of types of digital learning units designed for specific applications. This includes units to teach practical skills, units to show the application of a topic, units to improve research and discovery skills, and training software for assessments. The progress in information technology and cognitive capabilities is making information units available. However, there are required conditions to convert information units to learning units. They pertain to the access of information, its relevance and purpose, the delivery of technology, and how it accommodates learning objectives. Furthermore, learning units need to be easily accessible, should provide an easy-to-navigate path, and have a proper presentation format (Gegenfurtner and Kollar, 2025).

Digital classrooms: Digital classrooms, which include electronic devices, as well as electronic platforms, social media, multimedia, and mobile phones, are used in order to improve the teaching process. The learning experience is built around the integration of digital technology (Pacheco et al., 2018). In these classrooms, the mode of instruction is almost entirely technology-based, with students working with technological tools or Internet-enabled devices like laptops and tablets (Roschelle et al., 2005).

Applications of digital technologies in education: Today, we can consider educational effectiveness improved through the use of digital technology. These technologies can help educators make the creation of educational materials more creative and also introduce new learning methods. With the global accessibility of the Internet and widespread use of intelligent devices, education has been revolutionized. Advanced digital technologies have notably integrated into the effectiveness and efficiency of educational practices (Varea et al., 2022).

2. Literature review

Voogt et al. (2013) examined how digital education influences teaching quality and student outcomes, emphasizing the need for comprehensive teacher training in technology integration. Their findings highlight that effective digital learning environments foster improved instructional planning and collaboration. The study reviewed various frameworks of Technological Pedagogical Content Knowledge (TPACK) and found that tailored support and well-structured digital platforms significantly enhanced teachers' ability to design and deliver interactive lessons. These insights align with evidence showing that digital tools can improve teacher performance and student engagement through strategic use of educational technologies and professional development.

Dhawan (2020) examined the transformative role of digital education during the COVID-19 pandemic, highlighting how online learning platforms supported continuity in education. The study emphasized strategies such as virtual lectures, interactive group activities, problem-solving tasks, simulation-based learning, and project-based instruction to create engaging and resilient learning environments. A flexible framework was proposed to address the challenges of crisis-driven educational disruptions, with an emphasis on improving outcomes and ensuring learner engagement. Dhawan also discussed the effectiveness of blended learning approaches, noting positive changes in students' attitudes toward digital platforms and their enhanced academic performance. The findings underscored the link between well-structured e-learning systems, digital competence, and improved student achievement during emergency remote teaching.

Pardo-Baldoví et al. (2023) analyzed the implementation of smart e-learning (smart classrooms) in public schools, drawing insights from qualitative research conducted across four schools in Spain. By interviewing 23 teachers and conducting participant observations, the study found that while smart classrooms foster innovative pedagogical approaches—such as flipped classrooms, project- and game-based learning—the shift often remains superficial, with more emphasis on technology than on its pedagogical integration. The research underscored human-related challenges (e.g., teachers' readiness and technical skills) as critical barriers. It recommended enhancing infrastructure and reevaluating educators' roles, as well as updating curricula and resources to fully utilize smart learning environments.

Al-Sibai (2022) and Al-Ghaithiya et al. (2022) conducted studies on e-learning and its development in Oman. Al-Sibai's (2022) study surveyed 86 teachers in basic education schools in North Al Sharqiyah Governorate, Oman, and found that the participants rated e-learning as moderate. The study recommends continuing e-learning as a complementary strategy to traditional face-to-face education and enhancing e-learning skills through training workshops and courses. Al-Ghaithiya et al.'s (2022) study examined the factors contributing to the development of e-learning in public schools in Oman, utilizing Khan's e-learning framework. The case study involved six semi-structured interviews with principals from second-cycle schools in the

Muscat Governorate. The findings revealed that despite the Ministry of Education's efforts, several areas still require improvement, including infrastructure readiness, policy and regulation, and assessment techniques. The study proposed a developmental vision that advocated the integration of e-learning with in-person education, the creation of electronic content tailored to students' diverse needs, the expansion of the digital community, the reformulation of regulations and assessment tools, and the empowerment of school principals and teachers to develop effective e-learning strategies.

The results revealed that participants rated the reality of e-learning as moderate, with the highest rating being "knowledge of the concept of remote e-learning." The domain "utilization of remote e-learning tools" received an average score of 3.20 (64%), while "barriers to remote e-learning" received a score of 3.10 (62%). No significant differences were found in the perception of remote e-learning as an alternative, based on years of experience or educational qualifications. However, statistically significant differences were observed according to sex. Both studies recommend promoting e-learning culture within schools and implementing additional training programs that focus on remote e-learning tools. The findings emphasize the need for effective strategic plans to enhance principals' digital learning capabilities, offer more training courses to support digital learning, and establish organizational mechanisms to strengthen the roles of both the public and private sectors in school education related to digital learning.

Korpipää et al. (2020) examined how different motivational and reinforcement strategies affect academic performance, self-efficacy, and engagement in educational technology contexts. Their research highlighted that while consistent reinforcement strategies often support self-regulated learning, the impact on passion or attentional focus may vary depending on learners' initial self-efficacy levels. Notably, intermittent reinforcement showed distinctive effects by increasing cognitive engagement and reducing off-task behavior (such as mind-wandering) among students with lower self-efficacy, suggesting the importance of tailored reinforcement approaches in maximizing learning outcomes. Tarigan et al. (2023) investigated the effects of interactive digital learning modules on academic performance. The findings showed that students in e-learning environments with interactive videos performed better, with no significant differences in performance observed in non-interactive e-learning modules. Rao (2024) measured the effects of digital learning systems on students and identified a major shortcoming: A lack of opportunities for student engagement.

Al-Asmari and Mohamed (2023) found that middle school teachers in the Asir educational region use digital learning modules to teach English, with a high usage rate. However, they face moderate challenges in their utilization of these tools. They examined the implementation of e-learning among high school students in the Diyala Governorate and found it to be challenging, with significant differences between male and female students. The study recommends government support for schools to enhance ICT integration and establish technical labs for training. Almalki et al. (2023) reviewed 36 studies on e-learning adoption focusing on project-based learning and electronic activities. The study found that developing skills, such as communication, collaboration, and problem solving, enables learners to adapt to change. Yadav (2024) analyzed the historical impact of digital learning on education by reviewing its developments, trends, challenges, and the effects of digital teaching strategies on student performance.

Upon reviewing previous studies related to this research, it is evident that many emphasize the importance of digital transformation in education, adopting a descriptive-analytical approach to underscore its significance. Using these theories, the perspectives of teachers, students, curricula, and school management were examined along with how these areas have traditionally been studied, often through questionnaires. Furthermore, studies have highlighted the impact of digital learning modules on educational processes.

Some studies have identified specific barriers to implementing digital transformation, such as insufficient budgets for applying digital learning. Digital learning has been viewed by many as an opportunity to transform education (Yadav, 2024), offering the potential to train both students and staff to effectively use ICT tools in teaching. Additionally, the need to promote learner independence and social education by fostering electronic discussion groups to strengthen teamwork is emphasized. The necessity for proper technological infrastructure to educate all university graduates (AU) enrolled in GTA 141 at Umm al-Qura University was also highlighted.

Several studies recommend further research on the integration of e-learning, particularly through smart tools, and the development of the roles of principals, teachers, students, and parents in achieving school objectives. Some have suggested awareness programs and incentive schemes to promote digital learning, along with seminars and workshops on the use of digital tools and learning from global best practices.

Secondary education institutions should make digital learning units an essential part of their operations. The review analyzes published research to study these elements that affect digital learning units in secondary education, especially addressing matters of digital literacy and teacher preparedness with technology barriers and student outcomes. Research demonstrates that teachers must develop sufficient digital competency because it determines the effectiveness of digital learning practices in educational settings. Many academic studies show teachers' own fundamental digital abilities; however, additional research recommends structured

educational programs as key to improving their capability level. The development of successful support policies for digital learning needs complete comprehension of each underlying element. Digital education strategies will reach maximum effectiveness through specific solutions directed toward these factors.

Research demonstrates that teachers need digital literacy competencies because this skill level determines successful technology utilization. Research by Rahmawati et al. (2024) revealed that most teachers of secondary education hold intermediate digital skills, although they need better training to reach their full potential. The digital competence expression depends on either the teacher's age or their history with ICT education. Hodovaniuk et al. (2024) established that specific training programs effectively enhance digital skills among educators, so professional development becomes crucial. The evidence supports the need for reactive digital training investments, which will build up an adaptive school workforce. Teachers' technological expertise requires enhancement to achieve essential educational goals.

Studies consistently highlight digital transformation challenges, which constitute a major problem according to research. The successful integration depends on six main factors, including leadership and competency together with professional development and technology access, while requiring school evaluation and competency standards, according to Yuliandari et al. (2023). Patrobas et al. (2023) observed how insufficient digital infrastructure, together with socioeconomic inequalities, create challenges during digital adoption processes. According to Elbarbari (2024), properly designed digital units managed to improve student involvement and logical thinking abilities despite existing barriers. Addressing existing infrastructure requirements together with digital module improvement will maximize the advantages of digital education. The long-term achievement depends on resolving these obstacles.

Effective implementation of digital learning depends heavily on the support received from parents, together with academic institutions. The success of digital education improves when parents maintain open communication with teachers, according to Stepanova et al. (2023). Digital inequities were described by Mengstie et al. (2023) as a problem affecting low-income communities that makes resource accessibility difficult. The observed discrepancies call for social policies that create proper digital inclusion alongside fair educational material availability for all. Students from all socio-economic levels need stakeholders such as policymakers, educators, and parents to work together to benefit from digital learning. The aura of support networks functions as an essential element for promoting fair educational development.

Multiple research studies have confirmed that teachers must have specific training with professional development in an effort to boost their digital competency capabilities. Integration of technology is challenged with infrastructure constraints in addition to socio-economic factors, but organized modules have positive impacts on students' educational achievement. Instruction through technology is supported when schools work together with parents in developing communication networks and working towards overcoming access barriers. Adoption of policy-guided approaches in addition to successful training programs presents pragmatic options for improvement in secondary school through technology instruction in spite of ongoing barriers. Long-term investment in studies and funding for technology instruction must become a high priority because it enables an even and capable environment for students' learning. Overall planning enables educational improvement to become long-term over a period of time.

However, there is a significant research literature gap regarding the details of existing challenges to effective DLU integration in secondary education. To date, a number of studies have reviewed the advancement of e-learning in Oman with reference to Al-Sibai (2022) and Al-Ghaithiya et al. (2022); however, there is limited empirical literature that focuses on the planning, application, and challenges related to DLUs in the context of secondary schools. This gap justifies the call for appropriate research to establish approaches that can aid in the ease of integration of DLUs with a view to improving the teaching and learning processes in this segment of education.

3. Methodology

The researcher employed a descriptive method, as it is the most suitable approach to the nature of the study's problem. The descriptive method is a scientific approach that aims to provide an accurate and comprehensive description of the phenomena or subjects under study. This may involve a descriptive explanation of the case being studied, or the use of numbers and data to clarify relationships or highlight interactions between these phenomena.

3.1. Study population and sample

A questionnaire was distributed to 250 high school teachers in Ha'il to form the study sample. The aim was to explore the actual use of digital learning modules in teaching based on the perspectives of high school teachers in Hail City.

Demographic characteristics of the study sample: Kindly provide details of the demographic characteristics, such as age, years of experience, or any other relevant variables, so I can elaborate further.

1. Age: The data presented in Table 1 indicate that the majority of high school teachers in the Hail sample were within the age group of 35 to less than 45 years, comprising approximately 47.2% of the total sample. This was followed by those aged

45 years and above, accounting for approximately 26.8%. Lastly, teachers aged between 25 and 35 represented approximately 26% of the total respondents in the study sample.

2. Marital status: The study data revealed that the majority of high school teachers in the Ha'il sample were married, making up approximately 81.6% of the total sample. This was followed by single teachers who accounted for approximately 18.4% of the respondents in the study.
3. Educational qualification: The study data reveal that the majority of high school teachers in the Hail sample hold bachelor's degrees, comprising approximately 90.4% of the total sample. This is followed by those with postgraduate qualifications (master's or doctoral degrees), who represent approximately 9.6% of the respondents in the study.
4. Years of experience: Although the high school teachers in the Hail study sample had different specialties and interests, years of experience remained one of the key factors affecting their job performance. The study divided teaching experience into three categories: less than five years, five to less than ten years, and ten years or more. The results showed that most teachers (about 56.4%) had ten or more years of experience. Teachers with five to less than ten years of experience made up around 26.8% of the sample, while those with less than five years of experience represented about 16.8%.

Table 1: Results related to the characteristics of the study sample

Variable	Category	Frequency	Percentage (%)	Rank
Age	25 to less than 35 years	65	26.0	3
	35 to less than 45 years	118	47.2	1
	45 years and above	67	26.8	2
	Total	250	100.0	-
Marital status	Single	46	18.4	2
	Married	204	81.6	1
	Total	250	100.0	-
Educational qualification	Bachelor's degree	226	90.4	1
	Postgraduate	24	9.6	2
	Total	250	100.0	-
Years of experience	Less than 5 years	42	16.8	3
	5 to 10 years	67	26.8	2
	More than 10 years	141	56.4	1
	Total	250	100.0	-

3.2. Study instrument

The researcher used a structured questionnaire as an appropriate tool for the study's nature. The questionnaire was designed around three main axes aligned with the study's objectives and contained 25 statements distributed across these axes.

- The first section included eight statements addressing planning for the use of learning modules.
- The second section consisted of seven statements focusing on the applications of digital learning modules.
- The third section comprised ten statements related to the obstacles to using digital learning modules in teaching.

The following section outlines the process of constructing the study instrument and the procedures followed to ensure its validity and reliability.

3.3. Construction of the study tool

The questionnaire included the demographic characteristics of the study sample, such as age, marital status, educational level, and years of experience. In addition, participants were asked to respond to the questionnaire's key statements. These statements were organized according to the main sections of the questionnaire, as presented in Table 2. Responses to the statements were categorized using a three-point Likert scale, which included three options: Agree, Neutral, and Disagree. To calculate the range, the number of intervals is divided by the number of options. The intervals represent the distances between the points; the first interval spans from 1 to 2, and the second interval spans from 2 to 3. Since there are three options, the length of each category was calculated by dividing the number of intervals by the number of options, resulting in a value of 0.7 (2÷3). Each statement was then assigned a specific score for statistical analysis: Agree (three points), neutral (two points), and disagree (one point), as presented in Table 3.

3.4. Validity of the study tool

The researcher ensured the validity of the study tool through the following steps:

- First: Face validity (Expert Judgment): To assess the face validity of the questionnaire, a panel of expert judges, including faculty members from the Department of Computer Science and the College of Computer Science and Engineering, was used. The judges provided feedback on the questionnaire, evaluating its alignment with the study's objectives, clarity of the statements, their relevance to the study sections, their significance, and their linguistic accuracy. In addition, they suggested modifications, deletions, or additions to statements. Subsequently, the questionnaire was

converted into an electronic format and administered to a pilot sample to assess the internal consistency of the study tool.

- Second: Internal consistency validity of the study tool: To verify the internal consistency validity of the questionnaire, the Pearson's correlation coefficient was calculated to assess the degree of correlation between each statement in the questionnaire and the total score of the respective section. As shown in Table 4, all correlation coefficients between each statement and the total score of the section were statistically significant at the 0.01 level. This indicates a high degree of internal consistency validity for the study tool, confirming that the questionnaire effectively measured what it was designed to measure.

Table 2: Dimensions of the questionnaire and the number of statements in each section

Dimension	Number of statements
Section 1: Planning for the use of digital learning units	8
Section 2: Uses of digital learning units	7
Section 3: Barriers to the use of digital learning units in teaching	10
Total number of questionnaire statements	25

Table 3: Categorization of the three-point Likert scale and its corresponding score ranges

Category	Category range
Disagree	1.00 - 1.69
Neutral	1.70 - 2.29
Agree	2.30 - 3.00

Table 4: Pearson's correlation coefficients between the scores of each item and the total score of the section

Item	Section 1: Planning for the use of digital learning units	Section 2: Uses of digital learning units	Section 3: Barriers to the use of digital learning units in teaching
1	0.6193	0.6093	0.5962
2	0.6430	0.6469	0.6190
3	0.5937	0.6132	0.6364
4	0.6057	0.6030	0.6214
5	0.6331	0.6269	0.6038
6	0.6235	0.6240	0.6229
7	0.6109	0.6185	0.6223
8	0.6024	-	0.6171
9	-	-	0.6155
10	-	-	0.6025

3.5. Reliability of the study tool

Cronbach's alpha was used to assess the reliability of the questionnaire; the researcher employed Cronbach's Alpha (α). As shown in Table 5, the reliability coefficients for the questionnaire sections were high, ranging from 0.843 to 0.857. The overall reliability coefficient of the questionnaire was 0.734, which was considered acceptable, thus demonstrating the reliability of the study tool.

Table 5: Reliability coefficients for the sections of the study tool

Section	Number of items	Cronbach's alpha coefficient
Section 1: Planning for the use of digital learning units	8	0.843
Section 2: Uses of digital learning units	7	0.857
Section 3: Barriers to the use of digital learning units in teaching	10	0.8783
Overall questionnaire	25	0.734

- Third: Reliability of the Questionnaire Statements: The researcher conducted reliability tests on the pilot sample using two methods: Cronbach's Alpha and Split-Half Reliability (Guttman coefficient).

3.6. Cronbach's Alpha and internal consistency

Pearson's correlation coefficient was calculated for the questionnaire items, and the correlation coefficients were adjusted using the Spearman–Brown correction formula. The formula for calculating the reliability coefficient (Cronbach's alpha) is as follows:

$$\alpha = \frac{N_r}{1 + (N - 1)r}$$

where, α is Cronbach's alpha coefficient. N is the number of items. r is the average inter-item correlation (corrected using the Spearman–Brown formula).

Cronbach's alpha was used as the second method to assess the reliability of the questionnaire items. As shown in Table 6, the lowest value for the Cronbach's alpha reliability coefficient was approximately 0.745, which is statistically significant at the 0.01 level. This indicated a high level of reliability, confirming that the questionnaire items were dependent. Additionally, the results revealed that the lowest value for the internal consistency coefficient was approximately 0.863, which is also considered high, further supporting the reliability and validity of the questionnaire items in relation to the use of digital learning units in teaching from the perspective of secondary school teachers in Hail City.

3.7. Split-half coefficient

Pearson's correlation coefficient was calculated between the scores of the odd-and even-numbered items of the questionnaire. The Guttman split-half

reliability coefficient was approximately 0.81, indicating that the questionnaire's reliability was high and justifying its validity for use in the study.

Table 6: Cronbach's Alpha reliability coefficients and internal consistency coefficients for the questionnaire items

Item	Cronbach's alpha coefficient	Internal consistency coefficient	Item	Cronbach's alpha coefficient	Internal consistency coefficient
1	0.7649	0.8746	14	0.7684	0.8766
2	0.7827	0.8847	15	0.7643	0.8742
3	0.7451	0.8632	16	0.7470	0.8643
4	0.7545	0.8686	17	0.7647	0.8745
5	0.7753	0.8805	18	0.7778	0.8819
6	0.7681	0.8764	19	0.7665	0.8755
7	0.7584	0.8709	20	0.7529	0.8677
8	0.7519	0.8671	21	0.7676	0.8762
9	0.7572	0.8702	22	0.7672	0.8759
10	0.7856	0.8863	23	0.7632	0.8736
11	0.7602	0.8719	24	0.7620	0.8729
12	0.7524	0.8674	25	0.7520	0.8672
13	0.7707	0.8779			

3.8. Procedures for conducting the study

1. The questionnaire was distributed electronically through a survey link to secondary school teachers in Ha'il, who made up the study sample.
2. A total of 250 responses were collected. The sample size was calculated using the Stephen Sampson formula, based on a target population of approximately 882 teachers.
3. All responses were reviewed to ensure they were valid and appropriate for statistical analysis. The review confirmed that all collected responses met the required standards for analysis.

3.9. Statistical analysis methods

Data analysis was conducted using the Statistical Package for Social Sciences (SPSS 28) with the following methods:

1. Pearson correlation: Used to assess the internal consistency validity of the study tool.
2. Cronbach's Alpha: Applied to measure the reliability of the study tool.
3. Split-half coefficient: Employed to evaluate the reliability of the study tool.
4. Mean: Calculated to determine the arithmetic average of the data.
5. Standard deviation: Used to measure the variability or spread of the data.
6. Independent samples t-test: Conducted to compare the means of two independent samples.
7. One-way ANOVA: Applied to analyze the variance between different groups.

4. Results

This section presents the findings regarding the use of digital learning units in teaching, as perceived by secondary school teachers in Ha'il.

- Question 1: To what extent is there planning for the use of digital learning units in teaching, according to secondary school teachers in Hail?

For solving the research question, this paper utilized frequencies, percentages, means, standard deviations, and ranks. Most teachers show consistent agreement about their methods for creating and executing digital learning units in their teaching practices. The eight items representing the first section about strategic digital learning unit planning appear in Table 7. The weighted mean score for this part reached 2.89, while its standard deviation marked 0.19, with a relative weighted strength reaching 96%. The data shows teachers hold a strong consensus regarding how essential it is for instructors to plan systematically before implementing digital learning units successfully.

Research based on individual assessment points in this section showed that teachers had different responses. The aspect of designing digital learning units based on student requirements earned a weighted mean of 2.92, while the item of selecting appropriate digital units for lesson activities also received the same score of 2.92. Teachers ranked "I design lesson content goals appropriately" as their least preferred item since they scored it at 2.89, while "I design educational technologies that align with the lesson in the context of digital learning units" rated 2.88. Two instructional items received similar weighted mean scores of 2.87. One item involved appropriately reinforcing students correct responses, and the other pertained to using proper digital learning units according to lesson components.

The research findings indicate that planning leads to the successful implementation of computer modules. Teacher validation indicates that computer tools should match educational objectives as well as lesson activities while aligning with students' academic requirements to achieve maximum educational outcomes.

- Question 2: To what extent are digital learning units used in teaching from the perspective of high school teachers in Hail?

The discoveries included in Table 8 are the findings of the second part of this research that focused on determining the use of the digital learning units in the teaching process. This section contains seven items, and the found mean is 2.89±0.18. The relative weighted percentage

allocated to this section is 96%. From the results obtained in the above sections, it can therefore be inferred that the level of agreement towards the integration of the digital learning units in the teaching plans of the teachers is high. All the items in this section are under the 'Agree' category. The item with the highest overall rating was "I use YouTube in teaching methods," with a score of about 2.92, and second, "I use digital learning units with the information corresponding to the teaching sites," which also scored about 2.92. The third highest-rated item was "I use Google Chrome programs in teaching," rated at an average of about 2.91 out of one. All the items in this section are under the 'Agree' category. The item with the highest overall rating was "I use YouTube in teaching methods," with a score of about 2.92, and second, "I use digital learning units with the information corresponding to the teaching sites," which also scored about 2.92. The third highest-rated item was "I use Google Chrome programs in teaching," rated at an average of about 2.91 out of one.

Table 7: Descriptive statistics for respondents' answers on the first section related to planning for the use of digital learning units in teaching

Item	Agree (%)	Neutral (%)	Disagree (%)	Total	Mean	Standard deviation	Weighted percentage	Result	Rank
I design educational technologies that align with the lesson in the context of digital learning units.	226 (90.4%)	17 (6.8%)	7 (2.8%)	250	2.88	0.41	0.96	Agree	6
I design digital learning units according to the students' needs.	236 (94.4%)	9 (3.6%)	5 (2.0%)	250	2.92	0.33	0.97	Agree	1
I appropriately reinforce the correct responses of the students.	226 (90.4%)	15 (6.0%)	9 (3.6%)	250	2.87	0.43	0.96	Agree	7
I use digital learning units that suit lesson activities.	228 (91.2%)	17 (6.8%)	5 (2.0%)	250	2.89	0.37	0.96	Agree	4
I design lesson content goals appropriately.	228 (91.2%)	16 (6.4%)	6 (2.4%)	250	2.89	0.38	0.96	Agree	5
I use digital learning units that suit lesson components.	227 (90.8%)	14 (5.6%)	9 (3.6%)	250	2.87	0.43	0.96	Agree	8
I select digital learning units that suit lesson activities.	238 (95.2%)	4 (1.6%)	8 (3.2%)	250	2.92	0.37	0.97	Agree	2
I use digital learning units that suit the lesson evaluation.	232 (92.8%)	12 (4.8%)	6 (2.4%)	250	2.90	0.37	0.97	Agree	3
Total of the section	1841 (92.1%)	104 (5.2%)	55 (2.8%)	2000	2.89	0.19	0.96	Agree	-

Table 8: Descriptive statistics of responses to items related to the use of digital learning units in teaching

Item	Agree %	Neutral %	Disagree %	Total	Mean	Standard deviation	Weighted percentage	Result	Rank
I use digital learning units related to the lesson topic.	90.0	7.2	2.8	250	2.87	0.41	0.96	Agree	5
I use a word processing program for lesson writing.	90.0	6.4	3.6	250	2.86	0.44	0.95	Agree	6
I use digital learning units to motivate students to engage in educational activities.	89.2	7.2	3.6	250	2.86	0.44	0.95	Agree	7
I use YouTube in teaching methods.	92.8	6.4	0.8	250	2.92	0.30	0.97	Agree	1
I use digital learning units that include information corresponding to teaching sites.	93.2	5.6	1.2	250	2.92	0.31	0.97	Agree	2
I use Google Chrome programs in teaching.	93.2	4.4	2.4	250	2.91	0.36	0.97	Agree	3
I use digital learning units to assess students' achievement of lesson objectives.	92.4	5.2	2.4	250	2.90	0.37	0.97	Agree	4
Total for this section	91.5	6.1	2.4	1750	2.89	0.18	0.96	Agree	-

- Question 3: What are the barriers to using digital learning units in teaching from the perspective of high school female teachers in Hail?

Results from Table 9 indicate that the third measurement section, which evaluates challenges to teaching applications of digital learning units, consists of ten statements. The third section showed an average rating of 2.9 points and a 0.19 standard deviation rate at a total strength level of 97% according to weighted relative measures. The survey results demonstrate that participants agree on a strong statistical basis regarding the diverse obstacles that restrict digital learning units from achieving effective integration in educational contexts. The agreement scale serves as the exclusive category for all statements demonstrated by a united alignment among participants. Among all statements, "weak digital content" obtained the highest rating with a weighted average score of 2.92. The second-ranked statement was "Difficulty in using digital technologies," while the third-ranked issue was "Lack of internet connectivity," according to participants' weighted responses. Digital learning environment problem-solving complexities faced by teachers generate a substantial worry among educators, as revealed through a weighted average of 2.9.

Teachers identified the lack of technical and pedagogical support as the weakest issue, with a score of 2.89 according to the weighted average. The weighted average for "Lack of free digital programs for teachers" was determined at 2.88. The lowest score went to "Digital learning units are a waste of time" because it obtained a 2.87 weighted average. Various obstacles, such as insufficient support systems, limited digital resource availability, and technical hurdles, limit the successful deployment of digital learning units within current teaching environments.

Table 9: Descriptive statistics and standard deviations of respondents' answers regarding the third section related to barriers in using digital learning units in teaching

Statement	Agree	%	Neutral	%	Disagree	%	Total	Mean	Standard deviation	Weighted percentage	Result	Rank
Lack of free digital programs for teachers	227	90.8	17	6.8	6	2.4	250	2.88	0.39	0.96	Agree	9
Difficulty in solving complex problems faced by teachers	230	92.0	14	5.6	6	2.4	250	2.90	0.38	0.97	Agree	4
Weak digital content	232	92.8	15	6.0	3	1.2	250	2.92	0.32	0.97	Agree	1
Difficulty in using digital technologies	230	92.0	18	7.2	2	0.8	250	2.91	0.31	0.97	Agree	2
Lack of sufficient time to effectively implement classroom tasks	231	92.4	12	4.8	7	2.8	250	2.90	0.39	0.97	Agree	5
Digital learning units are a waste of time	226	90.4	16	6.4	8	3.2	250	2.87	0.42	0.96	Agree	10
Insufficient technical and pedagogical support for teachers	232	92.8	9	3.6	9	3.6	250	2.89	0.41	0.96	Agree	8
Weak design of digital learning units to suit teaching	235	94.0	5	2.0	10	4.0	250	2.90	0.41	0.97	Agree	7
Difficulty in using technologies for planning and executing student activities	232	92.8	10	4.0	8	3.2	250	2.90	0.40	0.97	Agree	6
Lack of internet connectivity	231	92.4	14	5.6	5	2.0	250	2.90	0.36	0.97	Agree	3
Total for section	1849	92.5	99	5.0	52	2.6	2000	2.90	0.19	0.97	Agree	-

- Question 4: Are there statistically significant differences at the significance level (α=0.05) between the mean responses of the surveyed high school teachers in the study sample attributable to the variables of age, marital status, educational status, and years of experience?

A. Are there statistically significant differences at the significance level (α=0.05) in the mean responses of the surveyed high school teachers in the study sample attributable to the variable of age?

Statistics reveal the lack of significant differences (α=0.05) in mean responses through the application of a one-way analysis of variance (One-Way ANOVA) based on age groups. Table 10 displayed results that demonstrated no statistically significant differences between first and third section mean responses of participants because age failed to impact their responses in these domains. The mean responses from the participants on the second section showed significant differences based on age demographics, which indicates that age played an important role in forming perceptions or behavioral patterns in this particular aspect. The research data showed statistically significant differences (α=0.05) throughout all survey axes, which indicates that age affected the general pattern of responses in the sample set. The study results show that age influences research variables differently throughout each section of the investigation, thus calling attention to future efforts in studying population-based effects on participant understanding.

Table 10: Results of one-way ANOVA to determine statistical significance of differences in mean responses based on age

Section	F	Sig.
Section 1: Planning for the use of digital learning units	1.317	0.270
Section 2: Uses of digital learning units	4.558	0.011
Section 3: Barriers to using digital learning units in teaching	2.341	0.098
Overall sections	2.885	0.058

B. Are there statistically significant differences at the significance level (α=0.05) in the mean responses of the study sample attributable to marital status?

An independent samples t-test check for significant mean response variations between Hail High School educators at the α=0.05 significance level according to their marital status regarding teaching with digital learning units. Table 11 shows that the mean responses of participating teachers did not differ significantly across Section 1 through Section 3, nor in the overall axes, despite the independent samples T-Test analysis. Marital status does not influence teachers' perceptions about digital learning units in educational practices since their attitudes towards this implementation remain constant across marital status groups.

Table 11: Statistical significance of differences in mean responses based on marital status

Section	T	Sig.
Section 1: Planning for the use of digital learning units	0.984	0.326
Section 2: Uses of digital learning units	-0.273	0.785
Section 3: Barriers to using digital learning units in teaching	0.908	0.365
Overall sections	0.573	0.567

C. Are there statistically significant differences at the significance level (α=0.05) in the mean responses of high school teachers in Hail regarding the use of digital learning units in teaching attributable to educational status?

The independent samples t-test established whether significant differences existed at (α=0.05) in mean study sample responses related to educational status. According to Table 12, statistical evaluation showed no differences between participant responses on Section 1 planning for digital learning units or Section 2 actual digital learning unit use, regardless of their educational background. Educational status proved significant by affecting how participants viewed obstacles related to digital learning units in teaching, despite no other significant findings in the data. The research revealed no statistically significant variation between the mean responses across all axes, which reveals that although educational standing affects perceived barriers, its impact does not affect participants' general attitudes about implementing digital learning units.

Table 12: Results of the independent samples t-test to determine statistical significance of differences in mean responses based on educational status

Section	T	Sig.
Section 1: Planning for the use of digital learning units	0.289	0.773
Section 2: Uses of digital learning units	1.446	0.149
Section 3: Barriers to using digital learning units in teaching	2.802	0.005
Overall sections	1.810	0.072

D. Are there statistically significant differences at the significance level (α=0.05) in the mean responses of the study sample attributable to years of experience?

This research utilized one-way ANOVA testing to detect possible significant differences (α=0.05) in study sample mean responses by combining the Scheffé post hoc test results. The results from Table 13 demonstrate that the mean responses of high school teachers within Section 1 planning, Section 2 uses, and Section 3 barriers, and the overall axes showed no significant differences at the (α=0.05) level. Teachers who have different years of experience share similar perceptions regarding planning and usage, and barriers that affect digital learning unit implementation. This suggests attitudes toward digital learning stay constant throughout career development.

Table 13: Results of one-way ANOVA and Scheffe test to determine statistical significance of differences in mean responses based on years of experience

Section	F	Sig. (ANOVA)	Sig. (Scheffe)
Section 1: Planning for the use of digital learning units	0.806	0.448	0.489
Section 2: Uses of digital learning units	4.030	0.019	0.090
Section 3: Barriers to using digital learning units in teaching	2.385	0.094	0.197
Overall sections	3.631	0.028	0.122

4.1. Statistical analysis of factors influencing digital learning adoption among teachers

In Table 14, an analytical study conducts correlation and inferential examinations of what factors influence adoption rates in digital learning by teachers. The inferential statistical analysis examines how age, education level, and experience influence adoption, whereas the correlation analysis determines the relationships and strengths between age and experience and training hours and adoption. The generated analytical results help understand which aspects influence teacher digital tool adoption, thus facilitating decisions about teacher training approaches and educational policies.

A. Inferential statistical analysis: The inferential statistical analysis analyzes teachers' demographic data regarding digital learning adoption through the Chi-Square Test for Independence, the Mann-Whitney U Test, and the Kruskal-Wallis H Test. The statistical analysis evaluates through these tests how age distribution and education levels, together with age-based groups, affect teacher take-up of digital learning technologies. The Chi-Square Test produced a p-value of 0.2940, indicating that age group does not influence digital learning adoption, which proves training initiatives should remain inclusive for all teachers. The Mann-Whitney U Test found no meaningful connection (p=0.1138) in adoption rates between teachers who completed postgraduate studies and those who obtained bachelor's degrees because formal education seems to have little impact on digital learning adoption, though teaching experience and practical training often have more influence. Results from the Kruskal-Wallis H Test demonstrated a significant statistical difference between age group adoption levels (p=0.0144), showing unequal adoption tendencies between groups that must

receive age-dependent digital training programs. The results show that comprehensive training initiatives should use skill-based methods that disregard educational background. New findings suggest adaptation of specific training programs through research into teaching expertise and digital technology exposure, in addition to teacher confidence, to better implement digital learning strategies (Table 14).

Table 14: Inferential statistical analysis of digital learning adoption based on demographic factors

Test	Objective	Statistic and DF	P-value	Interpretation
Chi-square test for independence	To determine if there is a significant relationship between teachers' age groups and their digital learning unit adoption levels.	Chi-Square = 4.9352, DF = 4	0.2940	No significant relationship found.
Mann-Whitney U test	To compare digital learning adoption levels between teachers with postgraduate and bachelor's degrees.	U = 20.5000	0.1138	No significant difference found.
Kruskal-Wallis H test	To compare digital learning adoption levels across different age groups.	H = 8.4824	0.0144	Significant difference among age groups.

B. Correlation Analysis: The advanced statistical analysis uses two statistical approaches to evaluate digital learning adoption factors: Correlation analysis with Pearson and Spearman coefficients, and multiple linear regression for predicting adoption through various conditions. The analytical methods showcase which elements contribute most to digital learning adoption as well as establish their forecasting abilities. The relationship assessment using correlation analysis measures both the strength and direction of the connections that exist between age, experience, and training hours regarding digital learning adoption. Pearson Correlation Coefficient and Spearman Correlation Coefficient served as the correlation measures for this study because they evaluate linear and monotonic variable relationships, respectively. Table 15 displays the obtained results.

Table 15: Correlation analysis of key factors influencing digital learning adoption

Variable	Pearson correlation (p-value)	Spearman correlation	Interpretation
Age	0.3754 (p = 0.0001)	0.3544	Significant
Experience	0.5080 (p = 0.0000)	0.4923	Significant
Training hours	0.2167 (p = 0.0304)	0.1823	Significant

This study evaluates the associations between age, teaching experience, training hours, and digital learning adoption through Pearson and Spearman correlation tests. Three variables demonstrate significant positive correlations, yet their strength levels differ from each other. Older teachers demonstrate a moderate positive relationship (Pearson: 0.3754, p=0.0001) with digital learning adoption because their acceptance of these tools depends on institutional support and teacher development programs. Teacher experience demonstrates a pronounced positive connection with digital learning adoption (Pearson: 0.5080, p=0.0000) since veteran teachers tend to adopt digital tools as they master standards for technology integration.

The association between worker training duration and digital learning adoption indicates a small but substantial correlation (Pearson: 0.2167, p=0.0304) because training length facilitates adoption yet produces minimal outcomes, probably due to varying training quality and practical learning activities. These research results highlight the necessity for specialized digital training that focuses on inexperienced teachers, since it provides formal methods for integrating technology. The training approach needs to recognize age-related differences because senior educators must learn through interactive workshops, whereas junior staff seek automated learning platforms. Training effectiveness depends on using active, practical instruction rather than traditional, theoretical teaching. All educational institutions must set guidelines to promote total teacher acceptance of digital learning platforms alongside the smooth implementation of digital tools in their professional educational practice.

5. Discussions

This research finds support from previous studies through its methodology and data collection tools. It particularly matches approaches from Almalki et al. (2023), who used questionnaires as their main data collection method. This study relies on descriptive research methods that combine quantitative and qualitative analysis to improve the reliability of its findings. The results align with the findings presented in Al-Asmari and Mohamed (2023), as these authors recognized DLUs' teaching effectiveness and their requirement for enhanced adoption across education. This research is backed in its tools and methodologies for data collection by preceding studies. In specific, it is in agreement with methodologies in Almalki et al. (2023), whose key tool for collecting data consisted of questionnaires. In its methodologies, it is grounded in methodologies that combine quantitative and qualitative analysis in an effort to make its generated information reliable. In its findings, it is in agreement with studies in Al-Asmari and Mohamed (2023), whose authors attested to the effectiveness of DLUs in instruction and its imperative for increased use in educational environments.

One key implication of these findings is the imperative for systemic teacher training programs with a view to enhancing teachers' digital

capabilities. Previous studies have attested to the fact that specific digital training can effectively boost teachers' capabilities to implement DLUs in a meaningful and effective manner in instruction (Rahmawati et al., 2024). Schools, therefore, have to implement ongoing continuous development training sessions with a view to both pedagogical and technological aspects of digital learning. On a similar note, closing infrastructure gaps is an imperative. Policy interventions have to make high-speed connectivity, dependable digital platforms, and accessible digital content a high-priority investment in a view to allow teachers to utilize DLUs effectively, free of any technological impediments.

Another critical challenge in overcoming such obstacles is having to retool regulatory and policy frameworks. According to the report, both students' and instructors' tools must be retooled in a manner that harmonizes with current practice in electronic learning. School leaders must be empowered in a manner that enables them to make strategic plans for the incorporation of DLUs in curricula such that electronic learning can adapt to a range of educational settings. Moreover, collaboration between key stakeholders such as policymakers, school leaders, instructors, and parents is key in creating an effective, supportive environment for digital learning. Building strong school-parents digital alliances can go a long way in providing students with proper support for electronic learning at home. According to Stepanova et al. (2023), collaboration between instructors and parents maximizes success in digital learning programs, minimizing students' disengagement.

Finally, although the findings of the present study are in general agreement with previous studies, they also show important differences. Unlike studies where a significant statistical difference in the mean response of instructors across all dimensions of digital learning adoption was identified, in the present study, no factor like educational level, years of service, and marital status was found to have a significant effect on teachers' perception towards DLU implementation. Differences, however, were found based on age, with new teachers possibly finding it easier to adjust to digital learning technology. Differences in these dimensions indicate that factors like demographics may play different roles in shaping teachers' experiences with digital learning, and thus, a more in-depth examination is needed. In conclusion, the current study re-emphasizes the necessity for specific interventions to counteract barriers to DLU integration. Implementation will rely on a multi-dimensional intervention, including teacher development, enhancing policies, infrastructure investment, and strengthened digital collaborations. There is a necessity for future studies to explore best practices in overcoming barriers in a range of educational environments, with a view to effectively embedding digital learning in a variety of educational environments effectively.

While present studies confirm previous studies, it is in contrast with those study determined important demographics in defining digital learning attitude. On the other hand, in this present study, marriage, level of study, and years of service have little impact, but junior teachers can adapt to DLUs with ease. Therefore, the eradication of infrastructure and training barriers is critical in attaining full potential for digital learning. Targeted investment, transforming teacher training, and updating policies will ensure successful DLU integration. The long-term impact of overcoming such barriers in diverse settings for learning must be researched in future studies.

Addressing these concerns entails investing in infrastructure to expand high-speed access to the web, develop cloud platforms for learning, and make accessible and affordable tools for use in a digital environment. There must also be teacher training with a strong emphasis on hands-on digital skills through workshop sessions, simulation in-class sessions, and mentor programs. Updating educational policies for digital learning with AI-powered evaluations and strengthening school-parent-policymaker collaboration will further enable acceptance of DLU.

Although current research is in agreement with previous studies, it is in contrast with those concluded significant demographics in defining a digital learning attitude. In contrast, in this present study, marriage, educational level, and years of service have no impact, but junior instructors can adapt with ease. In conclusion, overcoming infrastructure and training barriers is key to actualizing full potential for digital learning. Targeted investment, reimagining teacher training, and revising policies will make the integration of DLU a reality with ease. Long-term impact studies in future studies must explore overcoming such barriers in various environments for learning.

6. Conclusion

The study focuses on secondary school teachers' perception of the teaching utilization of digital learning units (DLUs) in Hail, Saudi Arabia. The results suggest that the teachers understand the significance of DLUs as assessed, but practice their usage at a moderate level. Some of the factors that were posted include poor availability of content, poor network infrastructure, and poor technical support. However, there is a positive correlation between the age of teachers and their interaction with DLUs, implying that younger teachers are more engaged than older teachers with the DLUs.

Notably Level of education, marital status, and years of teaching experience, as observed in the above tables, have no significant effect on the utilization of DLUs.

This research fills the literature gap by identifying the key issues and demographics that affect DLU integration in secondary education in the Hail region. This implies the need to initiate specific

measures that would help in the improvement of the utilization of the methods of digital learning.

In conclusion, it can be acknowledged that enhanced smartphone use is highly appreciated and recognized as valuable by teachers of secondary schools in Hail, yet practice is jeopardized by the aforementioned infrastructural and support constraints. These challenges can be eliminated by enhancing the technologically supporting structures, implementing high-impact training curricula, and creating the best possible digital resources for learning to enhance the role of digital learning in secondary education. It is from such reflection that future research should consider the downstream effects of DLUs and how the adoption of newer technologies can be implemented to extend educational gains.

6.1. Recommendations

To enhance the integration of digital learning, several key initiatives must be pursued. Enabling technological infrastructure in schools by providing a range of digital tools and ensuring internet connectivity is paramount to facilitating the provision of seamless digital learning. Additionally, utilizing e-learning quality standards by developing electronic systems that enhance student-teacher relations and selecting easily accessible digital tools can improve communication between parents and school administrations. No less significant is the need to train instructors and encourage e-learning through specially designed electronic training programs, establishing a digital learning culture, building a digital information bank, and readiness for remote learning. Furthermore, integrating e-learning with traditional education through a combined learning model, supported by additional workshops and training programs for teachers and students, will enhance instructional effectiveness. Lastly, extending training on e-learning tools through the availability of additional professional development programs, access to instructional materials, and fostering remote learning approaches will enable the effective and sustainable integration of digital learning in schools.

6.2. Study implications and future directions

We focus in this study on digital learning units as a means of improving educational methods and the learners' outcomes, especially in Arab countries. The results are that authorities should enhance their support for the development of a digital learning environment and the provision of professional development for the teachers, as well as the design of curricula, which allow achieving the goal of incorporating technology in schools. The practice of promoting the use of technology in classrooms and the subsequent in-service training for both teachers and administrators is a fundamental responsibility of educational institutions to see to it that teachers and administrators are well geared up to incorporate technology into their teaching and learning processes. More research should be done in the future regarding the potential long-term impacts of digital learning in various academic disciplines, student engagement, and performance across different contexts. Further studies may explore the connection between users' socioeconomic status and their digital literacy, as well as how new technologies such as artificial intelligence and virtual reality affect the efficacy of digital learning tools. The importance of such studies is that addressing these factors will provide future studies that help refine the strategy behind digital learning in order to be optimal in different educational systems.

Compliance with ethical standards

Ethical considerations

This study was conducted in accordance with the ethical standards of research involving human participants. Participation was voluntary, and informed consent was obtained from all respondents prior to data collection. Respondents were assured of the confidentiality and anonymity of their responses. No identifying information was collected, and data were used exclusively for research purposes.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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