Exploring College of Education Students' Perceptions of the Educational Uses of Virtual Reality (VR) Technologies

Budour M. Almisad*, Ayda A. Aleidan, and Rabab D. Alsaffar

College of Basic Education, The Public Authority for Applied Education and Training (PAAET), Kuwait, Kuwait
Email: b.almisad@paaet.edu.kw (B.M.A.); Aa.aleidan@paaet.edu.kw (A.A.A.); Rd.alsaffar@paaet.edu.kw (R.D.A.)
*Corresponding author

Manuscript received March 12, 2024; revised May 21, 2024; accepted June 20, 2024; published September 14, 2024

***Abstract*—Integrating Virtual Reality (VR) in education is widely acknowledged as a promising tool for enhancing learning outcomes. As future educators, it is crucial to understand and leverage these emerging technologies to advance education. However, there is a need to comprehensively understand the status of future educators' perspectives on the educational applications of VR technologies. The current research paper aimed to examine college of education students' perceptions of educational uses of VR technologies. The participants' perceptions were measured using three dimensions: Awareness of VR technologies and their applications in education, motivations toward the educational uses of VR technologies, and obstacles for the educational uses of VR technologies. A descriptive research design was used in this study. A questionnaire instrument was used to collect data from the participants. The number of participants was 186 students. The findings indicated that students had a moderate level of awareness of VR technologies and their educational uses. However, the participants expressed high motivation toward the educational uses of VR technologies. In addition, the results indicated a moderate level of perceived obstacles to integrating VR technologies in education, among the examined perceived obstacles, the most significant barriers include the lack of training, lack of time for preparation, and the absence of technical assistance and facilities. Based on the results, a set of recommendations was provided.**

***Keywords*—virtual reality, students perceptions, Kuwait, college of education**

I. INTRODUCTION

VR has been considered as a standout among the most understood and hopeful instruments to propel learning results [1]. Within this dynamic landscape, VR technology emerges as a potent educational force with remarkable potential. It offers a plethora of advantages, fostering immersive and experiential learning. These technological innovations employ a diverse array of electronic tools to construct intricate three-dimensional realms that mimic physical reality. In the realm of education, VR empowers users to engage in lifelike encounters, interacting with the various components of this simulated environment. An intricate amalgamation of sensory immersion and sophisticated content representation defines the VR environment, a realm capable of faithfully reproducing both real and imaginative worlds [2]. This research paper delves into the perceptions of college of education students, a group poised to shape the future of education, on the educational uses of VR technologies, a topic of significant relevance in the current educational landscape.

There are different types of VR technologies, and these types require the use of different tools. One of the simplest forms of VR technologies is desktop VR. Desktop VR involves displaying a high-resolution panoramic image on a standard desktop computer or Smartphone. Users of desktop VR employ a mouse, keyboard, or touch screen to move and explore the virtual environment. Different movements are used to simulate the physical movements of the head and the body. For instance, to emulate movements toward and away from virtual items, the users of desktop VR can rotate the image or zoom in and out [3]. A popular example of desktop VR is a second-life application that is a three-dimensional virtual environment where users choose avatars to represent themselves and interact with other users and the bulk of the material in this application is user-generated [4]. A more sophisticated type of desktop VR is one that requires the use of desktop VR systems as well as other devices such as projection screens, glasses, or gloves [5]. Among the pinnacle advancements in VR technology, the utilization of a Head-Mounted Display (HMD) or the transformative Cave Automatic Virtual Environment (CAVE) stands as a testament to the cutting-edge potential [6, 7]. These sophisticated mechanisms not only envelop users in captivating visual landscapes but also stimulate their senses through auditory cues, tactile feedback, and intricate spatial arrangements. In addition to the main tools that are used to offer VR environments such as computers, HMD, and AVE, a variety of auxiliary tools can be used to facilitate the users' navigation and interaction in the VR environment. These tools include wands, tactile simulation, thermal imaging, force feedback, stereoscopes, various tracking devices, and data gloves [8].

Based on the users' perceptions of being present in a non-physical world, VR systems can be categorized into three types: non-immersive, semi-immersive, or fully immersive system [9]. Desktop VR represents a non-immersive system while the VR systems that use HMD or Cave AVE represent a fully immersive system. Semi-immersive VR experience is between non-immersive and fully immersive VR. Users in a semi-immersive VR environment would navigate a virtual environment using a computer screen or VR glasses while maintaining their connection to their immediate environment [10]. Diverse incarnations of VR technologies imbue the VR environment with a spectrum of fundamental attributes. These fundamental features encompass the simulation of reality, immersive engagement, the artifice of presence, interactive dynamics, and sensory feedback [11, 12]. A delineation between these technological expressions is discernible: desktop VR delineates a landscape of non-immersion with modest interaction and a subdued sense of presence, whereas

doi: 10.18178/ijiet.2024.14.9.2154

the HMD and AVE iterations unfurl a panorama of full immersion, heightened interaction, and an intense semblance of presence.

VR technologies find their way to various fields; these technologies can be employed to accomplish various tasks in medicine, entertainment, sport, engineering, and architecture [5]. In education, VR revolutionizes the learning landscape by transporting students to historical events, distant landscapes, or complex scientific phenomena, thereby fostering experiential and interactive learning. VR technologies can be used in various ways to achieve various educational purposes. VR technologies can be used to enhance students' educational and psychological competencies in the three domains of learning: cognitive, affective, and psychomotor [13]. Examples of these competencies in the affective domain include interest in the learning process, enthusiasm for learning, accomplishment motivation, aesthetic norms, and competing concerns [13]. Examples of some competencies in the cognitive domain include visual thinking capabilities, ICT-using competencies, fashion design competencies, creative thinking competencies, writing competencies, and decision-making competencies [13]. Examples of psychomotor competencies include manual or physical skills in various sports such as rhythmic exercise, long jump, weightlifting, basketball, volleyball, and soccer [13]. Examples of psychomotor include physical skills in nursing and music fields psychomotor competencies include physical skills in nursing and music fields, e.g., phlebotomy skills and Oud instruments [13]. VR technologies can be used to enhance students' higher-order thinking skills based on Bloom's taxonomy [14].

VR technologies can be used to facilitate a constructivist learning environment that is characterized by a student-centered learning environment, a meaningful, authentic, enjoyable, and engaging environment, fostering students' higher-order thinking, and allowing for collaboration among students [15–17]. In addition, VR technologies can be integrated into the educational system to facilitate rich distance learning experiences and virtual learning experiences [18].

The integration of VR technologies into the educational system needs careful planning and consideration [19, 20]. One of the main requirements for the integration of technologies in education is to understand stakeholders perceptions of such technology and its educational implications [21–23]. Future teachers are one of the main stakeholders when it comes to technological integration in education.

Taking into account the novelty of VR technologies, the educational potential of VR technologies in various educational fields, the proven benefits of the uses of VR technologies in school education, and the need to understand future teachers' perceptions of such technologies, the current study aimed to examine Kuwaiti college of education students' perceptions toward using VR technologies in education in terms of their awareness such technologies, awareness of the educational applications of such technologies, level of motivations to integrate such technologies in education, and perceived obstacles to integrating such technologies in education.

II. Theoretical Framework

The use of VR technologies in education represents an important opportunity to enhance teaching experiences and learning outcomes, it is necessary to cultivate a deep understanding of future teachers' multifaceted perceptions of VR technologies and their applications in educational settings. This section provides a theoretical framework that examines the awareness, motivations, and perceived obstacles related to the use of VR technologies in education.

A. Awareness of VR Technologies and Their Applications in Education

The extent of awareness that aspiring educators hold concerning VR technology is a pivotal factor in shaping their preparedness for the evolving landscape of education. This awareness transcends mere familiarity and delves into a comprehensive understanding of the multifaceted dimensions that VR technology encapsulates.

The level of awareness that prospective educators possess regarding VR technology is intricately tied to their comprehension of the presence and technical capacities of said technology. Their grasp of VR technology encompasses a broad spectrum of knowledge, including but not limited to the understanding of VR concepts, the diverse array of VR technologies available, the utilized input and output devices within the VR realm, fundamental attributes characterizing VR technology, its associated strengths and weaknesses, the requisite proficiencies essential for constructing VR environments, as well as the manifold applications of VR across various domains.

The depth of prospective teachers' cognizance of VR's educational applications is contingent upon their familiarity with both the practical implementations of VR technologies within educational settings and an appreciation for the pedagogical advantages that VR can confer. This entails not only comprehension of the diverse educational applications of VR but also a nuanced recognition of the pedagogical merits inherent to VR adoption and the strategic integration of VR into the educational journey. Noteworthy examples within the literature highlight the manifold pedagogical dividends that VR technologies can bestow, including but not limited to fostering collaborative learning environments, catalyzing exploratory learning experiences, bolstering students' self-assurance and belief in their abilities [24], nurturing constructivist learning milieus and social interactivity [25], and fortifying students' capacities to adeptly resolve real-world challenges [26].

However, beyond examining students' awareness of VR technologies and their applications in education, it is crucial to examine prospective educators' motivation to adopt VR technologies for educational purposes. The next section will explore the various potential motivational factors to adopt the integration of such technology in education among individuals.

B. Motivations for the Integration of Technology in Education

Prospective educators' motivation toward the integration of technology in education is related to their general tendency toward using and applying such technology in their educational practice. Examining individuals' motivation concerning specific behaviors is vital as it enriches the emotional dimension of those individuals about the given behavior. In addition, studying individuals' motivation toward specific behavior would help in identifying how to unify attitudes toward such behavior. According to Self-Determination Theory (SDT), Ryan and Deci [27] distinguish between two types of motivations based on the various incentives or objectives that inspire action. These types are intrinsic and extrinsic motivations, where intrinsic motivation refers to doing something because it is naturally engaging or delightful while extrinsic motivation refers to doing something because it results in a separate outcome. The literature has identified various and interlarded motivational factors for instructors to integrate technology into education. Some of these factors are related to the technology itself such as being easy to use, useful, fun, interactive, testable, and adaptive [28, 29]. Some other factors related to the effect of the use of technology on educational practice such as enhancing teaching methods and increasing access to education [28]. In addition, some of the motivational factors related to the integration of technology are related to the potential benefits of technology for students, such as increasing students' achievement and motivation. Moreover, some instructors attributed their motivation to integrate technology into their education based on administrative reasons such as accessibility of adequate support and financial incentives [30–33] and other motivational factors might be related to the social influence [34]. Furthermore, teachers might be motivated to integrate technology into their educational practice due to personal purposes such as their knowledge and skills on how to integrate technology into education, their attitudes, and their interests [28, 32].

Furthermore, to understand students' perceptions of VR technology integration in education, it is equally important to examine the perceived obstacles they might face. Identifying and addressing these barriers is important for creating effective strategies to support the adoption of technology. The following section will examine various perceived obstacles that might hinder the integration of VR technology in educational settings from the perspective of future educators.

C. Perceived Obstacles to the Integration of Technology in Education

Prospective educators' perceived obstacles to integrating technology in education refer to the hindrances experienced by teachers to use and apply technology in their educational practice education. Technology integration in education might face different types of obstacles. Like teachers' motivation toward the use of technology in education, obstacles to the use of technology can be categorized into internal and external barriers [35]. Ertmer [35] described internal barriers as second-order barriers while external barriers as first-order barriers. Internal barriers are related to teachers' attitudes and beliefs in terms of their interest in using technology, their knowledge and skills, confidence, ability, and feelings of comfort [36]. Examples of external barriers include time constraints, availability of reliable tools and resources, lack of administrative and professional support, lack of financial support, lack of social support, lack of technical support, and barriers related to the security issue of the technology [36]. In another way of classifying the obstacles to technology use in education, Hew and Brush [37]. identified six groups of obstacles that include "(a) resources, (b) institution, (c) subject culture, (d) attitudes and beliefs, (e) knowledge and skills, and (f) assessment" (p.223). Tosuntaş, Çubukçu, and Tuğba, [38] reported another classification of obstacles to the use of technology in education. They identified seven barriers to technology integration that include "resources, knowledge and skills, institution, attitudes and beliefs, assessment, subject area culture and habitus".

Enhancing the measurement of participants' adoption of VR technologies in education requires a nuanced consideration of both the inherent qualities of the technology itself and the individual characteristics of the participants involved. The inclination of aspiring educators to incorporate technology into their practice hinges on the distinct attributes of each technology.

III. Literature Review

Several research studies have meticulously examined the perspectives of educators and prospective teachers regarding the utilization of VR technologies and their subsequent integration into teaching and learning. For instance, in Australia, Cooper *et al* [39] explored pre-service teachers' perceptions regarding VR technologies and their applications in teaching and learning. The researchers used a case study design that involved 41 participants. The participants reported favorable evaluations of VR technologies in the classroom due to some factors that include the ability of VR technologies to engage students, the immersive capabilities of the VR platform, and the extent to which the VR technologies may provide students with learning experiences they could not otherwise have with other tools. However, concerns raised by participants related to monitoring-related issues, financial expense, and applying the technology safely and helpfully, as well as their quite low self-efficacy to use VR technologies in their teaching. Furthermore, the participants were often less aware of VR's ability to support and encourage collaborative learning and more aware of its immersive and engagement potential. In another study, Bower, DeWitt, and Lai, [40] examined the factors that would affect pre-service teachers' intention to employ immersive virtual reality in education. A cross-sectional survey design was used in the study, where 106 pre-service teachers completed a questionnaire. The findings indicated that the dimensions of the second Unified Theory of Acceptance and Use of Technology (UTAUT2) were a good fit for describing pre-service teachers' intention to use immersive VR technologies in education. These dimensions were performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit. In addition, the findings revealed that pre-service teachers ranked habit as having the lowest importance and hedonic motivation as having the greatest effect on their intention to use VR technologies in education. Moreover, the findings showed that pre-service teachers' intentions to utilize immersive VR technologies were restricted by a variety of external constraints such as access, logistics, and assistance, internal obstacles such as perceptions and experience, and design concerns such as technical skills and ideas for instructional meaningful assignments).

In Russia, Khukalenko, Kaplan-Rakowski, and Iushina, [23] conducted a large-scale study that aimed to examine teachers' attitudes toward the use of VR technologies as tools for teaching and learning. A cross-sectional survey design was used in the study, where 20,876 teachers completed a questionnaire. The results indicated that overall, participants' opinions on the usage of VR technologies in teaching were only moderately favorable. Although there was not a significant association between instructional strategies and the degree of integration of VR technologies, more conventional teaching strategies were linked to lower degrees of VR technology integration. The findings showed a link between the frequency of VR use for general purposes and the degree of VR integration for educational purposes. However, there was only a minimal link between the frequency of VR use and the availability of IT staff. In another study in India, Nachimuthu and Revathi [41]. examined future teachers' level of awareness of VR technology. The study followed a descriptive research design in which 350 students completed a questionnaire. The results showed that participants had an above-average awareness of VR technology.

In the Arab world, some studies focused on the integration of VR technologies in schools. The VR technologies were used in various educational fields that include social subjects [42] English language ([43] science [44] Math [45] geography [46] information technology [47] history [48] physical education [49] philosophy [50]. The uses of VR technologies in these fields served wide different benefits that include enhancing students' love of learning [42], enhancing students' learning performance and skills for visual thinking [51] increasing students' involvement in the learning process [43] enhancing students' motivation and attitudes towards the use of technology [52] improving students' sports skills [49] enhancing students' thinking and creative skills [53]. VR technologies can be employed to support student's learning at the different levels of school education, higher education, vocational training, and special education [13].

In the Middle East, several studies examined the integration of VR technologies in education. However, most of these research studies used experimental design to assess the effect of the use of VR technologies on students' performance in specific knowledge and skills. For instance, Almisad [13] conducted a study that aimed to review the published research in the Arab world and examine the applications of VR technologies in education. The researcher reviewed 85 studies that were published in the last decade. The findings showed that the great mass of the examined research studies employed various experimental study designs. Tests and assessment forms were the most frequently utilized data collection tools in the research under consideration. Additionally, the participants in the research under consideration were either college or high school students. In most of the research, there were less than 100 participants. Most of the examined research used desktop VR. Although the research studies' objectives varied, most of them concentrated on how the use of VR technologies would affect the growth of psychomotor and cognitive abilities.

However, there were a limited number of research studies focused on the K-12 and higher education instructors' perceptions of VR technologies and their applications in the educational field in the Arab world. For instance, Alfalah [24] examined the perception of information technology (IT) faculty members regarding the use of VR technologies as a teaching aid in a university. A case study design was used in the study with 11 faculty members participating in the study. The findings indicated that most respondents were familiar with using technology in education. The great majority of them also demand that their students use technology. Most instructors believe that using technology can improve student learning within their disciplines, foster student-centered learning, allow students to interact with the course material and create their own, and allow students to interact with the course material and create learning pathways. Additionally, educators support the use of VR technologies in the classroom to improve collaborative learning, involve students in the learning process, encourage discovery learning, and assist students develop greater self-confidence. Moreover, the participants did not believe it would be difficult to purchase a VR device; they believed that their students would be aware of the potential advantages of VR technologies. In another study, Al-Aqali, [54] examined female teachers' perceived obstacles to integrating VR technologies in teaching mathematics in Saudi Arabia. The researchers used a descriptive research design in which 93 female teachers completed a questionnaire. The findings indicate that the participants strongly agreed that there were several obstacles to integrating VR technologies in their teaching of mathematics. These obstacles were related to the lack of required resources and tools such as a VR lab, required VR devices and equipment, VR technologies that support the Arabic language, and technical teams to design and produce educational VR technologies. Some other reported obstacles were related to VR technologies, which are expensive to produce and provide limited social interaction. In addition, the teachers reported that students' lack of familiarity with VR technologies, knowledge, skills in using VR technologies, and confidence in using VR technologies represent obstacles to using VR technologies in teaching mathematics. In addition, the participants reported that their lack of skills to use VR technologies and lack of time to deal with VR technologies might affect their use of such technologies in their teaching.

In Kuwait, a few studies focused on the use of VR technologies for educational purposes. For instance, Alenezi, [55] examined Kuwaiti in-service teachers' perceptions of the obstacles to using VR applications in teaching. A cross-sectional survey design was used in the study, where 182 teachers completed a questionnaire. The results showed that the participants moderately agreed that there were difficulties employing VR technologies in their teaching. The difficulties were related to the limited time of the class, insufficient training for the teachers to use VR technologies, lack of administrative support, lack of enough time to design and produce educational VR technologies, lack of required devices and tools to use VR technologies, lack of continuous technical support, lack of rewards to use VR technologies, and lack of VR technologies that support the Arabic language. In addition, the participants believed that VR technologies were inappropriate for use in some educational fields.

The current state of virtual reality integration in Arab schools remains in its infancy, primarily marked by preliminary experimentation involving a limited cohort of participants. Teachers and future teachers are the main stakeholders responsible for the successful integration of technology in education. The purpose of the current study differed from some previous studies that were conducted in the Arab world in terms of examining three dimensions of participants' perceptions including awareness of VR technologies and their applications in education, level of motivation to integrate VR technologies in education, and perceived obstacles to integrating VR technologies in education. Some of the examined previous studies focused on participants' perceived obstacles to integrating VR technologies for educational purposes [54, 55]. The participants in the current are different from the participants in the examined previous studies in terms of focusing on pre-teachers while the participants in the examined previous studies were in-service faculty members [24], in-service teachers [54, 55]. The research design in the current study is like the research design of some examined in previous research [54, 55]. The current study used a questionnaire instrument to collect data from participants; the questionnaire was developed based on the theoretical framework and examined previous studies.

IV. Research Method

The current study adopted a quantitative research method. College of Education students participated by completing a questionnaire. The following sections present overviews of the research questions, the data collection instrument used, the data collection procedure, and the data analysis process.

A. Research Questions

1) What is the extent of awareness regarding VR technologies and their applications in education among College of Education students?
2) What are the levels of motivation for integrating VR technologies in education among College of Education students?
3) What are the perceived obstacles to integrating VR technologies in education among College of Education students?

B. Data Collection Instrument

Based on the examined theoretical framework and previous studies, the researcher developed a questionnaire instrument. The questionnaire consisted of five sections. The first section consisted of four questions regarding participants' demographic variables, including gender, age, academic year, and major. The second section consisted of ten questions that aimed to measure participants' awareness of VR technologies. The awareness of VR technologies scale was developed based on previous studies [24, 56]. The third section consisted of ten questions that aimed to measure participants' awareness of the educational applications of VR technologies. The awareness of the educational applications of VR technologies scale was developed based on previous studies [24–26, 56]. The fourth section consisted of ten questions that aimed to measure participants' motivation to integrate VR technologies into education. The motivation scale was developed based on previous studies [57, 58]. The fifth section consisted of ten questions that aimed to measure participants' perceived obstacles to integrating VR technologies in education. The obstacles scale was developed based on previous studies [35, 54, 55, 59, 60].

C. Data Collection Procedure

The data was collected using digital questionnaires. To recruit college of education students to participate in the current study, the researcher asked a group of faculty members in a college of education in Kuwait to have their students participate by sending the electronic link to the questionnaire. The students completed an electronic questionnaire. The data was gathered during Kuwait's second semester of the 2022/2023 academic year.

D. Data Analysis

Descriptive analyses were used to answer the three research questions regarding participants' awareness of VR technologies and their applications in education, the level of their motivation to integrate VR technologies in education, and perceived obstacles to integrating VR technologies in education. The descriptive analysis involves calculating the mean and standard deviation for each question in the questionnaire and the mean and standard deviation for each dimension in the questionnaire.

The current research employs the following criteria to categorize students' responses on the five-point Likert scale. If the mean (M) is 3.67 or higher, it is categorized as "High." If the mean (M) falls between 2.34 and 3.66, it is classified as "Moderate." When the mean (M) is less than 2.34, it is assigned to the "Low" category, such classification was adopted from previous studies [61, 62]. This classification method was used to describe students' responses to the questionnaire's items. This classification method facilitates the organization of data into high, moderate, or low groups based on mean values, ensuring distinct differentiations among these ranges.

E. Participants

The present study comprised a group of 186 students from the College of Education at a university in Kuwait. Notably, most participants, constituting 90.9% of the sample, were female students, whereas the remaining 9.1% were male students, accounting for a total of 17 individuals. A substantial proportion of the students, constituting the great majority, fell within the age range of 21 to 25 years old. A small fraction, precisely 15.6% (n = 29) of the participants, were between 18 and 20 years old. It is worth noting that a minor number of participants, specifically 14%, exceeded the age of 25 years, and this group consisted of 26 students. The data on age demographics provides valuable insights into the composition of the study's participants. As the ages of the participants indicate, 86.5% (*n* = 161) were in their third and fourth academic years. In contrast, a smaller number of participants 13.4% (*n* = 25) were in the first and second academic year. Concerning the participants' areas of study, it is worth noting that the entire group consisted of students enrolled in the college of education at a university in Kuwait. Most participants, comprising 40.9% (*n* = 76), were specialized in educational technology. Interestingly, the great part of the remaining participants displayed a balanced distribution, with close to one-eighth majoring in three diverse disciplines: Islamic education, physical education, and art education. Lastly, a subset of participants, totaling 20.4% (*n* = 38), pursued various other educational majors. Table 1 shows the demographic characteristics of the participants.

Table 1. Characteristics of the participants

Variable	Category	Frequency	Percent
Gender	Female	169	90.9
	Male	17	9.1
Age	18-20	29	15.6
	21-25	131	70.4
	Older than 25	26	14
Academic Year	First	1	.5
	Second	24	12.9
	Third	83	44.6
	Fourth	78	41.9
Major	Educational technology	76	40.9
	Physical education	25	13.4
	Art education	24	12.9
	Islamic education	23	12.4
	Interior design education	10	5.4
	Math education	9	4.8
	English education	7	3.8
	Science education	7	3.8
	Others	5	2.6

V. RESULTS AND DISCUSSION

This section presents the study's findings, focusing on the reliability of the questionnaire as it is measured based on the participant's responses, and their responses to the research questions regarding awareness, motivation, and perceived obstacles related to integrating VR technologies in education. Each subsection addresses a specific aspect of the research, providing a comprehensive overview of the data collected and its implications.

A. Questionnaire's Reliability

To ensure the questionnaire's reliability, Cronbach's Alpha for each subscale was computed. Table 2 shows the values of the Cronbach's alpha coefficients. Since the values of Cronbach's alpha coefficients are close to 1, they suggest high internal consistency, indicating that the items in the scale are strongly related to each other and are likely measuring the same construct. Furthermore, to validate the questionnaire instrument, it was distributed to a group of faculty members from the college of education, representing various majors, for item assessment. Their responses were used to adjust the questionnaire instrument.

Table 2. The values of the Cronbach's alpha coefficients

N	Scale	Number of Items	Cronbach's alpha
1	Awareness of VR technologies	10	0.88
2	Awareness of the educational applications of VR technologies	10	0.90
3	Motivation to integrate VR technologies in education	10	0.96
4	Perceived obstacles to integrating VR technologies in education	9	0.90

B. Awareness of VR Technologies in Education Among Students

Regarding the first part of the questions that examine students' awareness regarding VR technologies, the findings indicate that students have a moderate level of awareness regarding VR technologies. Among the items assessed, the students responded most positively to item number one (M=3.46, SD=1.41), expressing that they understand the meaning of VR. Additionally, they responded least favorably to item number two (M=2.84, SD=1.28), indicating their enthusiasm for following news related to VR technology. These responses suggest that students possess a superficial understanding of VR. Moreover, when examining their interests and attitudes toward VR, the students' responses showed higher interest in learning and using VR technologies compared to their actual knowledge about this technology. The findings aligned with previous studies that showed that future teachers had above average future teachers had above-average awareness of VR technologies [41]. Furthermore, upon examining their interests and attitudes toward VR, the students' responses revealed a greater eagerness to learn and utilize VR technologies compared to their actual knowledge about this technology. In other words, they displayed a keen interest in VR, despite having limited familiarity with its practical aspects. Table 3 presents the average scores and standard deviations of College of Education students' responses to the scale designed to assess their level of awareness concerning VR technologies.

Table 3. Means and standard deviations for college of education students' responses to the scale that examined their extent of awareness regarding VR technologies (n=186)

	Awareness of VR technologies	*M*	*SD*	*Level*
1.	I know the meaning of VR.	3.46	1.41	Moderate
2.	I eagerly follow news related to VR technologies.	2.84	1.28	Moderate
3.	I can distinguish between the different types of VR technologies.	2.88	1.29	Moderate
4.	I know about the used input and output devices of VR technologies.	2.85	1.29	Moderate
5.	I would like to use VR technologies.	3.61	1.29	Moderate
6.	I am interested in learning about the use of VR technologies.	3.61	1.32	Moderate
7.	I know how to use VR technologies.	3.02	1.29	Moderate
8.	I know about the various applications of VR technologies in various fields.	2.87	1.31	Moderate
9.	I know about the capabilities of VR technologies to simulate a real-life experience.	3.15	1.43	Moderate
10.	I know about the advantages and disadvantages of VR technologies.	3.28	1.33	Moderate
	Total	3.16	0.91	Moderate

Note. Five-point Likert scale containing 5 responses ranging from strongly agree to strongly disagree was used.

Like the findings on students' awareness of VR technologies, the students also demonstrated a moderate but higher level of awareness concerning the applications of VR in education. Among the items evaluated, the students showed the highest favorability towards item 7 (*M* = 3.68, *SD* = 1.30), which stated that "I know that VR technologies can be integrated into education to facilitate collaboration among students ", while they displayed the lowest favorability towards item 2 (*M* = 2.72, *SD* = 1.27), which stated that " I eagerly follow academic news related to VR technologies in education". Table 4 shows mean and standard deviations for the participants" responses to the scale that examined their extent of awareness of the applications of VR technologies in education. An in-depth examination of each item's responses indicated that the students possessed moderate knowledge regarding the advantages of utilizing VR technologies, specifically in terms of fostering collaboration among students and promoting discovery-based learning. The findings aligned with the results of previous studies that showed that the teachers had moderately favorable opinions regarding the use of VR technology for educational purposes [23].

Table 4. Means and standard deviations for college of education students' responses to the scale that examined their extent of awareness of the applications of VR technologies in education (n=186)

Awareness of the educational applications of VR technologies	M	SD	Level
1. I know about the applications of VR technologies in education.	3.05	1.36	Moderate
2. I eagerly follow academic news related to VR technologies in education.	2.72	1.27	Moderate
3. I know about the educational potential of different types of VR technologies.	3.08	1.30	Moderate
4. I would like to integrate VR technologies into my future teaching activities.	3.63	1.33	Moderate
5. I am interested in learning about the applications of VR technologies in education.	3.46	1.33	Moderate
6. I know how to effectively integrate VR technologies into my future teaching activities.	3.03	1.35	Moderate
7. I know that VR technologies can be integrated into education to facilitate collaboration among students	3.68	1.30	High
8. I know that VR technologies can be integrated into education to promote discovery learning	3.67	1.30	High
9. I know that VR technologies can be integrated into education to design students' centered learning environment.	3.63	1.28	Moderate
10 I know that VR technologies can be integrated into education to enhance students' abilities to solve real-life problems	3.48	1.30	Moderate
Total	3.34	.96	Moderate

Note. Five-point Likert scale containing 5 responses ranging from strongly agree to strongly disagree was used.

C. Motivation for Integrating VR Technologies in Education Among Students

In contrast to the outcomes related to students' awareness of virtual reality (VR) technologies and their potential within the educational context, the students exhibited a high level (*M* = 3.67, *SD* = 1.09) of motivation when considering the integration of VR technologies into their prospective careers as teachers. The mean scores for individual items range from 3.55 to 3.84, showing that students' motivation levels vary across different aspects of VR integration. Notably, item 7 received the highest favorability rating among the students, (*M* = 3.84, *SD* = 1.22). This statement centered on the student's willingness to incorporate VR technologies into their future teaching practices if they were encouraged by educational administrators. The higher favorability score indicates that students are more open and motivated to embrace VR tools if there is institutional support and guidance. Conversely, item 10 garnered the lowest favorability rating among the surveyed students (*M* = 3.65, *SD* = 1.32). This statement revolved around the idea of using VR technologies in future teaching endeavors based on personal enjoyment. The lower favorability score suggests that the students' motivation to utilize VR in teaching is not primarily driven by personal enjoyment alone. Items 1, 2, 3, 4, 5, and 6 all reflect the perception that VR technologies would enhance teaching and learning. These items generally have mean scores above 3.65, indicating that students acknowledge the pedagogical benefits of VR. Item 8, related to the ease of using VR technologies, received a moderate score (*M* = 3.55, *SD* = 1.32). This indicates that students may have some concerns or uncertainties about the ease of incorporating VR into their future teaching practices. Table 5 shows means and standard deviations for the participants' responses to the scale that examined motivation to integrate VR technologies in their future careers. The findings aligned with the results of previous studies that showed that educators had positive intentions to use VR technologies for educational purposes [40].

Table 5. Means and standard deviations for College of Education students' responses to the scale that examined motivation to integrate VR technologies in education (n=186)

Motivation to integrate VR technologies in education	M	SD	Level
1. I would use VR technologies in my future teaching because they would enhance students' learning.	3.65	1.32	Moderate
2. I would use VR technologies in my future teaching because they would improve the quality of teaching practice.	3.76	1.19	High
3. I would use VR technologies in my future teaching because they would increase my productivity as a teacher.	3.66	1.33	Moderate
4. I would use VR technologies in my future teaching because they would enhance students' learning.	3.69	1.27	High
5. I would use VR technologies in my future teaching because they would enhance my effectiveness as a teacher.	3.68	1.30	High
6. I would use VR technologies in my future teaching because they would provide several pedagogical benefits.	3.66	1.24	Moderate
7. I would use VR technologies in my future teaching if the educational administration encouraged me to do so.	3.84	1.22	High
8. I would use VR technologies in my future teaching because they are easy to use.	3.55	1.32	Moderate
9. I would use VR technologies in my future teaching because it is fun.	3.69	1.34	High
10. I would use VR technologies in my future teaching because I would enjoy them.	3.56	1.32	Moderate
Total	3.67	1.09	High

Note. Five-point Likert scale containing 5 responses ranging from strongly agree to strongly disagree was used.

D. Perceived Obstacles to Integrating VR Technologies in Education Among Students

The students' perspectives on the potential hindrances associated with integrating VR technologies into education were characterized by a moderate level of agreement (M = 3.43, SD = 0.98); among the various items evaluated, two specific statements garnered higher levels of favorability from the students. Item number five (M = 3.63, SD = 1.36) stood out, suggesting that "Lack of training on how to use VR technologies" is perceived as a significant obstacle to the integration of VR technologies in teaching. Similarly, item number eight (M = 3.63, SD = 1.21) also received notable favorability, proposing that the "Lack of knowledge and skills on how to create and integrate VR technologies" is seen as a substantial barrier to incorporating VR technologies into teaching practices. Upon closer examination of the responses, it becomes evident that students are more aligned in recognizing the importance of addressing training-related challenges. Item number five's higher mean score indicates a shared acknowledgment among students that a lack of proper training in using VR technologies presents a considerable impediment to their successful integration into educational settings. Furthermore, item number eight's favorable reception underscores the students' consensus regarding the significance of possessing the requisite knowledge and skills for both creating and integrating VR technologies into the educational process. This suggests that students perceive a need for competence not only in using the technology but also in incorporating it seamlessly into the educational curriculum. Furthermore, the results showed that Students moderately agree that the lack of facilities, technical assistance, and time constraints pose obstacles to VR integration. Moderate agreement is observed for the lack of incentives, Arabic language resources, and the perceived importance of VR in education.

The findings aligned with the findings of similar research studies [54, 55]. However, in contrast to these more widely agreed-upon challenges, students exhibited lower favorability towards item number four (M = 2.93, SD = 1.43). This statement posited that "The nature of my courses does not fit the use of VR technologies." The lower mean score here indicates that students view the compatibility of their courses with VR technology as a comparatively less significant obstacle. Table 6 shows means and standard deviations for the participants' responses to the scale that examined their perceptions of the obstacles to integrating VR technologies in their future careers.

Table 6. Means and standard deviations for pre-service teachers' responses to the scale that examined their perceptions of the obstacles to integrating VR technologies in education. (n=186)

N	Perceived obstacles to integrating VR technologies in education	M	SD	Level
1.	Lack of facilities to integrate VR technologies in schools	3.54	1.30	Moderate
2.	Lack of adequate technical assistance in schools to integrate VR technologies in schools.	3.55	1.31	Moderate
3.	Lack of enough time to prepare for the use of VR technologies.	3.58	1.32	Moderate
4.	The nature of my courses does not fit the use of VR technologies	2.93	1.43	Moderate
5.	Lack of training on how to use VR technologies.	3.63	1.36	Moderate
6.	Lack of financial and moral incentives to integrate VR technologies in schools	3.50	1.39	Moderate
7.	Lack of Arabic language recourses to integrate VR technologies in schools.	3.47	1.32	Moderate
8.	Lack of knowledge and skills on how to create and integrate VR technologies.	3.63	1.21	Moderate
9.	The integration of VR technologies in education is not important.	2.99	1.41	Moderate
	Total	3.43	0.98	Moderate

Note. Five-point Likert scale containing 5 responses ranging from strongly agree to strongly disagree was used.

VI. Conclusions and Recommendations

The study highlights a moderate level of awareness and high level of motivation among students regarding VR technologies and their applications in education. While students recognize the pedagogical benefits of VR, there is a gap between their interest and their practical knowledge. Institutional support is important in bridging this gap and fostering a more profound understanding and effective integration of VR in education. Based on the findings, the study recommends to:

- increase efforts to familiarize students with VR concepts and applications through dedicated educational programs and resources.
- • ensure strong institutional support to motivate students and facilitate the integration of VR technologies in teaching.
- implement comprehensive training programs to equip students with the necessary skills to create and use VR technologies effectively.
- invest in facilities, technical support, and resources to overcome obstacles related to VR integration.
- emphasize and showcase the educational advantages of VR through workshops, seminars, and real-life examples.
- encourage educational administrators to actively support VR integration and the likelihood of successful implementation.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Almisad supervised the development of the data collection instrument. Alsaffar and Aleidan supervised the process of collecting and analyzing the data. All authors have written, read and agreed to the published version of the manuscript.

Acknowledgment

The authors wish to thank the Public Authority for Applied Education and Training (PAAET) in Kuwait.

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