

Research Article

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Virtual Reality-based Technologies in Higher Education: A Mixed-Methods Study of Faculty Views in the UAE

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Abstract

Background/purpose. The integration of immersive technologies in education has been increasing. Such technologies include: the virtual reality (VR)-based technologies, which have raised engagement and interactivity, and foster the development of skills in academic settings. Thus, this study aimed to explore the attitudes of faculty members in Emirati higher education institutions toward the use of VR-based technologies. It also aimed to identify the associated challenges.

Materials/methods. A mixed-method approach was adopted. It involves the quantitative and qualitative approaches. A five-point Likert scale questionnaire was distributed online to faculty members in Emirati universities. 225 faculty members filled in the survey.

Additionally, 22 faculty members were interviewed through in-depth interviews. The sample is considered a random sample. Quantitative data were analyzed using the SPSS program. The qualitative responses were analyzed through conducting a thematic analysis.

Results. Faculty members generally exhibit positive attitudes toward the use of VR in education. The significant advantages of such use include: enhanced student engagement, improved problem-solving and critical thinking skills, and increased learning motivation. The associated challenges include high implementation costs, a lack of continuous training, and time constraints in content delivery.

Conclusion. VR-based technologies enhance the quality of education, and the sampled faculty members have a positive attitude towards using such technologies.

1. Introduction

The use of technology has been increasing rapidly. In fact, it became an essential part of people's daily lives (Hassan et al., 2024). Thus, the use of multimedia, animation, and interactive technologies in teaching and learning processes has been increasing significantly worldwide. This led to a shift in the use of the web in the teaching and learning processes. This shift is represented by the transition from conventional multimedia to virtual reality-based technologies.

Virtual reality-based technologies are represented in virtual reality (VR) applications and programs. They are represented in the technologies that employ 3D models, which initiate immersion and interaction and stimulate the imagination of the targeted learners. They are characterized by being more interactive, immersive, and intuitive than other technologies. They provide learners with real-time simulations that utilize three-dimensional computer graphics to mimic the real world. Thus, they provide learners with a realistic, safe environment to perform the required academic tasks (Huang et al., 2010).

Virtual reality (VR) can also be defined as a computer-generated, three-dimensional virtual environment that users can interact with. This environment can be accessed via a computer capable of projecting 3D information through screens or a wearable display (such as a head-mounted display (HMD)) and user identification sensors (Hamad & Jia, 2022).

It should be noted that using virtual reality-based technologies has several advantages. For instance, using virtual reality-based technologies enables students to keep up with the latest technologies and scientific advancements. That is because such use shall allow students to see the latest technologies and advancements. Additionally, such use will enable students to acquire and discover knowledge independently. That is because such technologies shall allow students to conduct virtual experiments on 3D virtual models. Such technologies shall allow students to examine and explore 3D virtual models of beings and objects. Thus, the use of such technologies will promote autonomous learning among students (Alfalah et al., 2018).

In addition, using virtual reality-based technologies makes the learning process more interesting and enjoyable, as it allows students to see objects in front of them as they are in reality, thanks to the use of 3D models. In addition, it makes learning enjoyable because it allows students to see places they have never visited or cannot visit due to the danger associated with visiting them. This will increase the students' motivation to learn and their attention during the learning process (Alfalah et al., 2018).

To add more, using virtual reality-based technologies improves the students' higher-order thinking skills (e.g., group collaboration, problem-solving, and critical thinking skills). That is because using such technologies allows students to see 3D virtual simulation models of the beings, phenomena, or items they are learning about. Such models enable students to focus on the finer details and examine them to gain knowledge. They also enable students to think critically about the details related to the targeted problem and interpret these details to offer a solution. They also enable students to conduct logical analyses and engage in group discussions (Chen et al., 2022).

Virtual reality-based technologies allow students to do tasks or work on projects that are deemed difficult due to having limited resources or being associated with many life-threatening risks. Thus, they provide learners with realistic learning experiences by accurately mimicking situations and environments. Additionally, they enable students to collect real-time data, allowing them to identify how they would react in various scenarios. For instance, they may be used to test how nursing students would react to several cases involving patients suffering from certain medical conditions. In addition, they allow students to present and modify virtual prototypes without having to dedicate much time, effort, and funds. For instance, the students majoring in engineering can present and

modify virtual prototypes of buildings without having to dedicate much time, effort, or funds to do that. This will enable students to identify defects in their prototypes and work on them (Hamad & Jia, 2022).

Since the spread of the Coronavirus (COVID-19), there has been a significant increase in the use of virtual learning environments. The virtual learning environments are created to look just like real-life learning environments, where students can walk around and work with their peers on projects and assignments. In virtual classes, students can participate in discussions and ask questions to their virtual instructors and receive pre-generated answers (Hamad & Jia, 2022).

Despite the numerous advantages of using virtual reality-based technologies in education, such technologies have their disadvantages. For instance, some students' questions may not be answered in an asynchronous virtual class because the answers to the questions were not uploaded. Thus, the information in the latter classes is limited to what is uploaded only. Hence, it is believed that virtual education cannot replace face-to-face education (Hamad & Jia, 2022).

In light of the advantages and disadvantages of virtual classes, it is worth noting that few studies have explored the attitudes of faculty members towards using virtual reality-based technologies. For instance, Al Harbi (2016) found that faculty members have positive attitudes towards virtual learning environments (VLEs) for teaching language studies in universities in Saudi Arabia. He also found that using engaging environments motivates students to learn. According to Ekunola et al. (2022), lecturers in the faculties of education have positive attitudes towards using virtual lecture halls. However, the researchers of the present study did not find a study exploring the attitudes of faculty members in Emirati higher education institutions toward the use of VR-based technologies and the associated challenges.

Hence, the researchers of the present study believe that it is significant to examine the attitudes of faculty members towards using virtual reality-based technologies in higher education institutions in the UAE. The term 'attitude' in this regard refers to a neural and mental state of readiness that is created based on past experiences. It has a directive or dynamic impact on one's response to the objects and situations related to the relevant experiences (Fazio, 2007).

To be more specific, this study aimed to

- Investigate the attitudes of faculty members towards the use of virtual reality-based technologies in higher education institutions in the UAE.
- Identify the challenges hindering the use of virtual reality-based technologies in higher education institutions in the UAE.
- Offer suggestions for handling such challenges.

This study aimed to answer the questions shown below:

Q.1. What are the faculty members' attitudes towards the use of virtual reality-based technologies in higher education institutions in the UAE?

Q.2. What are the challenges hindering the use of virtual reality-based technologies in higher education institutions in the UAE?

Q.3. What suggestions can be offered to handle such challenges?

In light of the aforementioned information, it is worth noting that this work is significant for the following reasons.

- As far as the researchers know, this research article is the first research article to investigate the faculty members' attitudes towards the use of virtual reality-based technologies in higher education institutions in the UAE.
- This work provides results that contribute to increasing the use of virtual reality-based technologies in Emirati universities. This will enable Emirati students and faculty members to stay up-to-date with the latest educational technologies and advancements.
- The results of this research work contribute to improving the quality of the education delivered to Emirati university students.
- This work serves as an important reference for researchers who want to investigate the effectiveness of using virtual learning technologies for training instructors or teachers
- This article shall encourage decision makers in the UAE to use a virtual learning environment for delivering university education. Thus, it contributes to improving the quality of university education in the UAE.

The researchers presented the conceptual framework of the present study below:

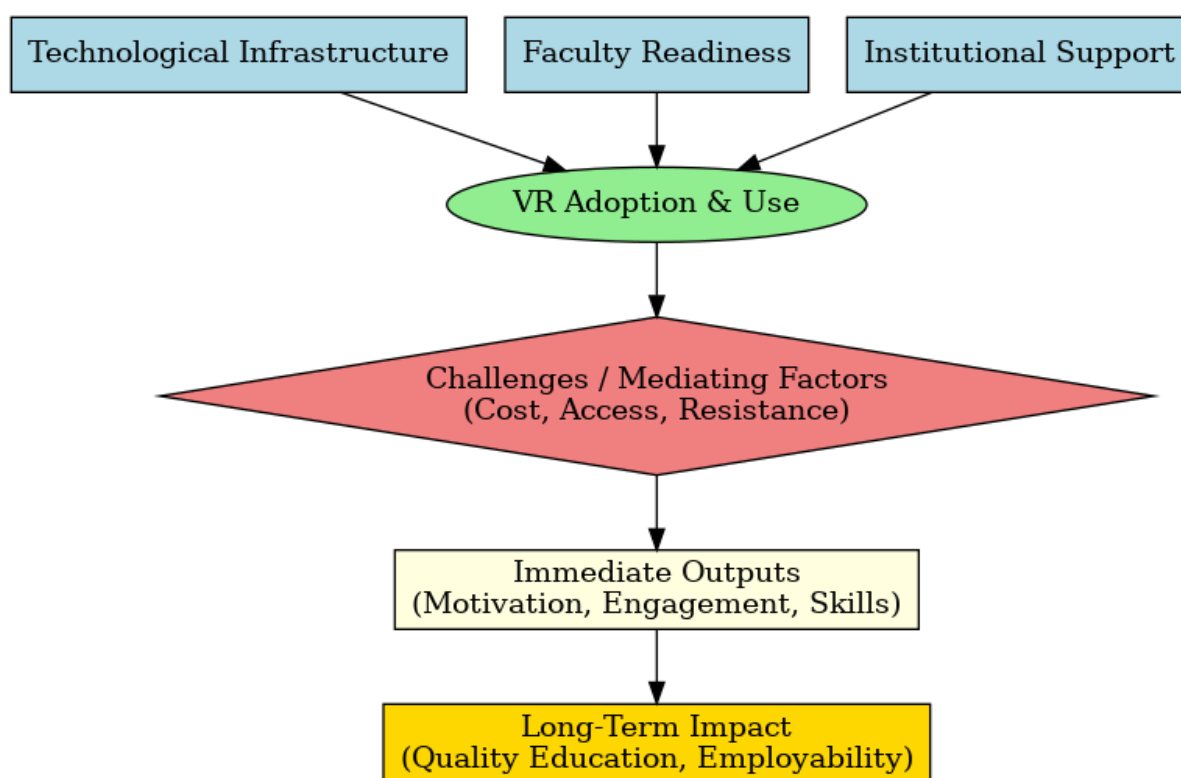


Figure 1. The Conceptual Framework

2. Literature Review

2.1. Definitions of Virtual Reality and its Technologies

Virtual reality-based technologies are represented in applications and programs that utilize 3D models, which facilitate immersion and interaction, stimulating learners' imagination. They are characterized by being more interactive, immersive, intuitive, and exciting than other technologies. They provide learners with real-time simulations in which three-dimensional computer graphics are used to mimic the real world. Thus, they provide learners with a realistic and safe environment to perform academic tasks (Huang et al., 2010).

Virtual reality can be defined as a computer-generated, three-dimensional virtual environment that users can interact with. This environment can be accessed via a computer capable of projecting 3D information through screens or a wearable display (such as a head-mounted display (HMD)) and user identification sensors (Hamad & Jia, 2022).

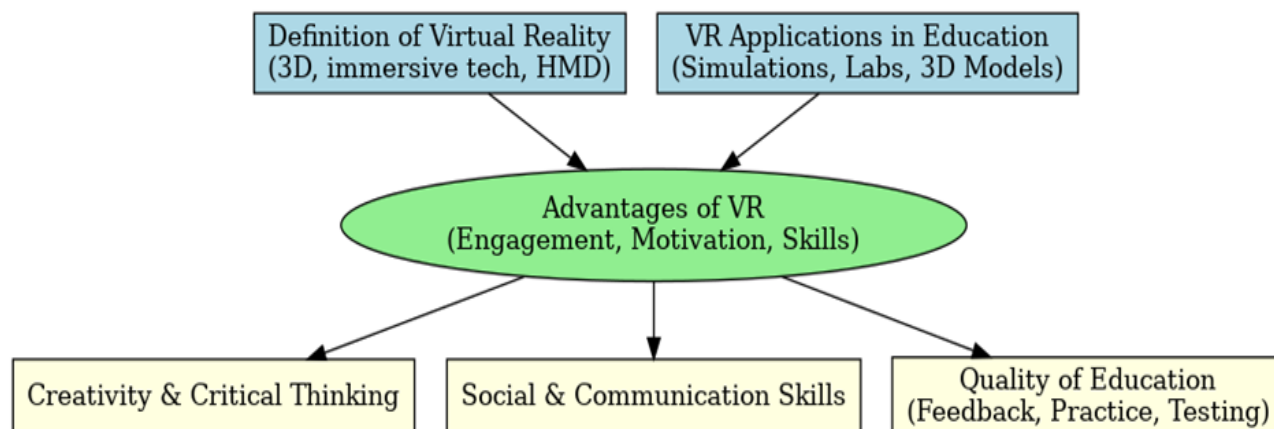


Figure 2. Theoretical Framework

2.2. Examples of Virtual Reality-Based Technologies

Examples of such technologies include: the virtual programs that offer simulation models for students majoring in medicine. The latter programs provide those students with effective and cost-effective feedback to ensure the physical safety of those students. They allow those students to repeat their learning experiences till mastering the targeted skill (Samadbeik et al., 2019). Other examples of virtual reality-based technologies include the virtual programs used in architectural design educational programs. The latter programs allow the students majoring in architecture to engage in digital 3D modelling, material and environmental simulation, realistic visualization, and remote collaboration (Aydin, S., & Aktaş, 2020).

Other examples of such technologies include virtual travel and tourism applications and programs. The latter applications and programs are beneficial for students majoring in art, history, or tourism. They enable students to explore new places and examine works of art and historical artifacts of value (Hamad & Jia, 2022). Other examples of virtual reality-based technologies include applications and programs that offer students virtual laboratories. The latter applications and programs are beneficial for students majoring in pharmacy, chemistry, or biology. They enable students to conduct complex experimental procedures with minimal physical risk. They enable students to overcome the barriers that exist in real-life learning environments. Such barriers include: the lack of sufficient workspaces to train large numbers of students. They also include: the time-consuming nature of training in the virtual environment. They include: having the samples contaminated (Hemme et al., 2023).

2.3. Advantages of Virtual Reality-Based Technologies

According to Lin et al. (2017), the use of virtual reality in education promotes creativity among students. Creativity is measured based on several areas (i.e., sensitivity, fluency, flexibility, originality, and elaboration). In terms of sensitivity, it is represented in paying attention to the key points and not missing details. Fluency is represented by thinking fluently and generating numerous ideas. In terms of flexibility, it refers to one's ability to view a thing from different perspectives and adjust ideas to overcome difficulties. Originality refers to one's ability to come up with new, personal, and unique opinions and ideas. Elaboration refers to one's ability to offer ideas and plans that are rich in detail (Lin et al., 2017).

Using virtual reality-based technologies promotes creativity among students because it engages them in practical experiences, rather than just having them read a text. It is because using virtual reality lets students observe the details related to the subject they are learning about. That will motivate the students to learn. It will help students develop a more positive attitude towards the subject they are learning about. Additionally, the use of virtual reality in education contributes to improving students' creative problem-solving skills. That is because such use allows students to identify the most important key points and focus on the details needed to solve the targeted problem (Lin et al., 2017).

Using virtual reality-based technologies contributes to improving the quality of education by offering students effective feedback and experiences that simulate real-life scenarios. It also improves the students' accuracy and performance when doing tasks, because it provides students with numerous opportunities to apply the knowledge they acquired (Samadbeik et al., 2018)

Using virtual reality-based technologies facilitates the learning process of abstract concepts by providing students with visual illustrations or examples that clarify the meanings of these concepts. In addition, it provides students with an appropriate testing environment that includes all the needed virtual resources. This environment is considered free from any physical risk (Nersesian et al., 2019).

Using virtual reality-based technologies improves students' higher-order thinking skills (e.g., group collaboration, problem-solving, and critical thinking skills). That is because such technologies enable students to view a three-dimensional simulation model of the concepts they are learning about. Such models allow students to pay attention to the little details and examine them. It allows students to examine and interpret the details related to the targeted problem. It allows students to conduct a logical analysis and engage in group discussions (Chen et al., 2022).

Using virtual reality-based technologies provides students with more opportunities for social interaction. For instance, students can create new social relationships with others in the virtual learning environment. Thus, such an environment allows students to practice their communication skills and develop their social skills. Such social skills include: social attribution, emotion recognition, and analogical reasoning skills. In fact, there are special virtual reality-based programs for developing the social and communication skills of autistic students. The latter students have difficulties in developing their social and communication skills. Such programs train their autistic users in recognizing and interpreting others' facial expressions, body language, and emotions based on their voices (Hamad & Jia, 2022)

Using virtual reality-based technologies makes the teaching-learning process more enjoyable and immersive. That is because such technologies enable learners to play 360° videos and navigate within the virtual environment. That shall provide the learners with a more immersive experience. Using such technologies shall allow students to interact with the world as they see fit. It shall allow students to have more control over what they want to pay attention to in a video. It shall allow them to see videos in a whole new way and from a new perspective (Hamad & Jia, 2022)

2.4. Challenges Hindering the Use of Virtual Reality-Based Technologies

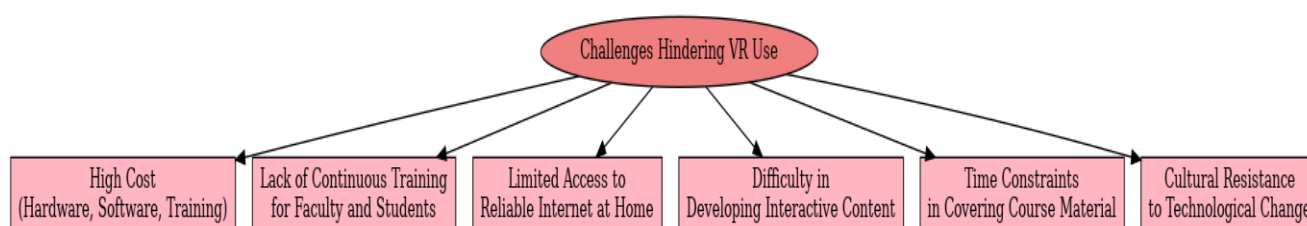


Figure 3. Challenges Hindering the Use of Virtual Reality-Based Technologies

There are several challenges hindering the use of virtual reality-based technologies. According to Singh and Devi (2009), such challenges include: the difficulty in changing the learning culture of students. In other words, some students are resistant to using technologies, primarily virtual technologies. It is challenging to change the learning culture of these students and instill in them a very positive attitude towards using such technologies. Other challenges include: the need to provide instructors with training in an ongoing manner to develop their skills in illustrating the material through the use of such technologies (Singh & Devi, 2009)

Other challenges also include: the difficulty of developing the required programs, software, and courseware. In other words, the academic material used in virtual environments should be interactive, relevant, user-friendly, and capable of facilitating self-learning. In addition, there must be specialists who possess extensive knowledge and expertise in developing programs and applications used for delivering education in a virtual learning environment. Other challenges include: difficulty in providing all students with equal access to the needed technologies for virtual education. Such a difficulty is attributed to differences between students in terms of the socio-economic status (Singh & Devi, 2009).

According to Agbele and Oyelade (2020), such challenges include: the lack of technical skills by many teachers and students. That slows down the teaching-learning process. It is attributed to the lack of technical training. Other challenges also include: the high cost of delivering virtual education. They also include the time-consuming nature of delivering such education. For instance, a high budget must be dedicated to procuring the necessary devices and equipment, as well as maintaining them. It must cover the costs of developing the required online content and training the human resources (Agbele & Oyelade, 2020).

Other challenges include the high poverty level among students in some countries, especially in developing countries. They include: having slow learners. It is difficult for the latter learners to keep up with their peers, as they have no teacher or peers around to ask them questions about the things that are difficult to understand. Other challenges include offering students too much flexibility in the virtual learning environment. Such flexibility may hinder students from showing commitment to the learning process and the preset deadlines. It may encourage some students to use the resources in the virtual learning environment for activities such as watching movies and playing games. (Agbele and Oyelade, 2020).

Other challenges include the difficulty in assessing students in virtual environments. That is attributed to having difficulties in sending feedback to all students. Other challenges include the difficulty in finding a strong internet connection. That requires concluding a contract with a reliable telecommunication company that's capable of providing the educational institution with a strong internet connection. Students must also have a strong internet connection at home, which can be challenging for some (Agbele & Oyelade, 2020).

2.5. Studies on Virtual Learning

The researchers reviewed the studies below:

Al Harbi (2016) examined the attitudes of faculty members towards virtual learning environments (VLEs) for teaching language studies in universities in Saudi Arabia. Through an adoption of a descriptive approach, 52 English language instructors were surveyed. It was found that the faculty members have positive attitudes towards virtual learning environments (VLE) for teaching language studies in universities in Saudi Arabia.

Lin et al. (2017) aimed to explore the impact of using virtual reality on students' leadership skills and creativity. They adopted an experimental approach. They sampled 104 students. Those students were selected from two (2) classes in Chang Jung Christian University, Taiwan. The researchers used

a pre-test and a post-test. They found that the use of virtual reality has a significant positive impact on the students' leadership skills and creativity.

Samadbeik et al. (2018) aimed to explore the impact of using educational virtual reality-based technologies on teaching students majoring in medical sciences. They conducted a meta-analysis. They reviewed 21 papers out of 1343. The twenty-one papers were chosen from Scopus, Web of Science, PubMed, Springer, and Google Scholar. The collected data were summarized and reported using the content analysis technique. It was found that the use of such technologies improved the learning experience of students and the quality of the delivered education. Such use also increased the accuracy and performance of the students in doing medical procedures. It reduced the extent of committing medical errors.

Akman and Çakır (2020) aimed to explore the impact of using an educational virtual reality game on the achievement and engagement of primary school students in mathematics. They adopted an experimental approach. They administered a pre-test and a post-test. The experimental group consists of 32 4th graders. It was taught through the use of a VR game. The control group consists of 32 4th graders. It was taught through the lecturing method. It was found that using educational virtual reality games has a significant positive impact on the achievement and engagement of primary school students in mathematics.

Liu et al. (2022) investigated the impact of immersive virtual reality classrooms on students' achievement, cognitive load, and motivation in science lessons. They used an interview, pre-test, post-test, and survey. 362 4th graders were sampled. They were allocated into control and experimental groups. Research has shown that utilizing immersive virtual reality classrooms has a significant positive impact on student motivation and achievement. It was found that such use significantly reduced the cognitive load.

Jans et al. (2023) investigated the impact of virtual reality on the clinical decision-making skills of undergraduate nursing students. They collected data through reviewing several studies published during the period (2010 - 2021). They reviewed seventy (70) articles and presented 18 studies. It was found that using VR improves students' critical thinking, clinical reasoning, clinical judgement, and clinical decision-making skills.

3. Methodology

The following sub-sections include data about instruments, sample, approach, population, and data analysis methods:

3.1. Approach

The researchers adopted the descriptive, analytical, and quantitative approaches. The latter approaches were adopted to process the data collected through the questionnaire. As added by Aspers and Corte (2019), the quantitative approach is represented in the approach used for processing numerical data.

The researchers also employed a qualitative approach to analyze the data collected through semi-structured interviews. According to Aspers and Corte (2019), the latter approach is represented in using qualitative methods for analysing qualitative data. It involves analyzing visual and historical texts, making observations, conducting interviews, examining life stories, and personal experiences (Aspers & Corte, 2019).

It should be noted that the researchers collected the required data during the summer semester of the year (2023/2024). They targeted the higher education institutions that are located in the UAE

3.2. Population and Sample

The population is represented by all faculty members working at Emirati higher education institutions. The questionnaire was uploaded to Google Form. Then, it was shared with faculty members through uploading it to several WhatsApp groups and individual chats. Thus, this study employs the random sampling method. Two hundred twenty-five faculty members filled in the questionnaire. The criteria for including the faculty members in the sample include the following:

- a. Being a faculty member
- b. Working in the UAE
- c. Knowing virtual reality-based technologies

In this regard, it should be noted that the results in this study cannot be generalized, because they are affected by the instrument and sampling method.

Data about the surveyed respondents is shown in the table below

Table 1. Distribution of the Surveyed Respondents is in Accordance with Gender, Rank, and University

Variable	Category	Frequency	Percentage
Gender	Male	125	55.5555556
	Female	100	44.4444444
Academic rank	Lecturer	25	11.1111111
	Assistant professor	100	44.4444444
	Associate professor	82	36.4444444
	Professor	18	8
University	University of Sharjah in Sharjah	32	14.2222222
	Umm Al Quwain University in Umm Al Quwain	29	12.8888889
	The British University in Dubai	27	12
	American University in Dubai	35	15.5555556
	Canadian University of Dubai	26	11.5555556
	Abu Dhabi University in Abu Dhabi	22	9.7777778
	New York University Abu Dhabi	32	14.2222222
	Khalifa University in Abu Dhabi	22	9.7777778

N=225

Through using the random sampling method. Twenty-two faculty members were chosen and interviewed (12 males and 10 females) through semi-structured interviews. It should be noted that

the answer sheets from each interview were entered into the computer system. Each answer sheet was encoded. That was done to ensure that the analysis results would not be affected by any bias.

The distribution of the interviewed respondents is in accordance with their gender, rank, and university affiliation, as shown below.

Table 2. Distribution of the Interviewed Respondents is in Accordance with Gender, Rank, and University

Variable	Category	Frequency	Percentage
Gender	Male	12	54.54545
	Female	10	45.45455
Academic rank	Lecturer	3	13.63636
	Assistant professor	9	40.90909
	Associate professor	8	36.36364
	Professor	2	9.090909
University	University of Sharjah in Sharjah	3	13.63636
	Umm Al Quwain University in Umm Al Quwain	4	18.18182
	The British University in Dubai	2	9.090909
	American University in Dubai	4	18.18182
	Canadian University of Dubai	3	13.63636
	Abu Dhabi University in Abu Dhabi	2	9.090909
	New York University Abu Dhabi	1	4.545455
	Khalifa University in Abu Dhabi	3	13.63636

N=22

3.3. Instruments

The instruments used in this study include a semi-structured interview and a five-point Likert questionnaire. This questionnaire was uploaded to Google Form. Then, it was shared with faculty members through uploading it to several WhatsApp groups and individual chats. Two hundred twenty-five faculty members filled in the questionnaire.

The questionnaire consists of two parts. The first part collects demographic data. The second part collects data about the respondents' views. The questionnaire was developed based on the works of Alfalah et al. (2018), Lin et al. (2017), Chen et al. (2022), Jans et al. (2023), Samadbeik et al. (2018), Akman & Çakır (2020), Nersesian et al. (2019), and Hamad & Jia (2022).

Regarding the interview, it consists of two questions. Those two questions are shown below:

Q.1. What are the challenges hindering the use of virtual reality-based technologies in higher education institutions in the UAE?

Q.2. What suggestions can you offer for handling such challenges?

The researchers developed the interview questions based on the study's objectives.

3.4. Validity of the Instruments

The researchers passed the questionnaire, in its initial version, to five faculty members. Those faculty members possess much knowledge and expertise in the field of educational technology. They were asked to assess the instrument in terms of clarity, language, and relevance to the study's goal. They were asked to make recommendations, modifications, and corrections where needed. After assessing the questionnaire, all the faculty members added that the instrument is free from any language errors. They also added that the instrument is deemed clear. They added that the instrument is well-designed, well-written, and relevant to the study's goals. However, one of them recommended making an addition to a statement to make it clearer. This statement suggests the following: "Using virtual reality-based technologies in higher education institutions in the UAE increases the students' motivation. The amended statement suggests the following: "Using virtual reality-based technologies in higher education institutions in the UAE increases the students' motivation to learn"

Regarding the validity of the interview, it was assessed through passing the interview questions to the same five faculty members to let them assess those questions in terms of clarity, language, and relevance to the goals. Those faculty members added that the questions are well-written and capable of meeting the intended goals. They did not make changes to the questions.

3.5. Reliability of the Instruments

The Cronbach alpha value was calculated to check the reliability of the questionnaire. It is 0.880. It is considered high because it is greater than 0.70, as it is added by Salehi & Farhang (2019).

To verify the reliability of the interview, the answers of the interviewees were analyzed by two expert groups. Each group consists of two experts. The results of their analysis were compared with each other to make sure that they are similar. The researchers found that the results of the analysis were similar. That means that the interview questions enjoy validity.

3.6. Statistical Analysis

The researchers conducted a qualitative analysis to examine the data collected through the interviews.

The quantitative data in this study were analyzed using the SPSS program. That was done to analyse the quantitative data through this program. In addition, the following statistical methods were used by the researchers to analyze the quantitative data:

- Means and standard deviations
- Frequencies and percentages
- The value of the Cronbach alpha coefficient

For classifying the calculated means, the criteria displayed below were adopted (Alderbashi, 2021)

Table 3. The Criteria that were Adopted for Having the Calculated Means Classified Into Three Categories

Range	Level	Attitude
2.33 or less	Low	Negative

2.34-3.66	Moderate	Neutral
3.67 or more	High	Positive

*Source: Alderbashi (2021)

The five-point Likert scale was used in the survey. It includes five main categories for rating the attitude. Those categories are displayed below (Al-Derbashi & Moussa, 2022)

Table 4. The Categories and Scores of the Likert Scale Used in This Research

Category	Score
Strongly agree	5
Agree	4
Neutral	3
Disagree	2
Strongly disagree	1

*Source: Al-Derbashi and Moussa (2022)

4. Results

4.1. First Question

Q.1.What are the faculty members' attitudes towards the use of virtual reality-based technologies in higher education institutions in the UAE?

Table 5. The Respondents have Positive Attitudes Towards Using Virtual Reality-Based Technologies in Higher Education Institutions in the UAE

No.	Statement	Mean	Std.	Level	Attitude
Using virtual reality-based technologies in higher education institutions in the UAE					
1	promotes autonomous learning among students	4.81	0.15	High	Positive
2	makes learning more enjoyable for students	4.76	0.29	High	Positive
3	increases the students' motivation to learn	4.88	0.32	High	Positive
4	increases the students' attention while learning	4.60	0.38	High	Positive
5	improves the students' group collaboration skills	4.73	0.48	High	Positive
6	improves the students' problem-solving skills	4.54	0.60	High	Positive
7	improves the students' critical thinking skills	4.63	0.55	High	Positive
8	improves the students' decision-making skills	4.50	0.23	High	Positive
9	develops the students' leadership skills	4.68	0.69	High	Positive
10	develops the students' social and communication skills	3.59	0.64	Moderate	Neutral

No.	Statement	Mean	Std.	Level	Attitude
11	promotes creativity among students	4.55	0.72	High	Positive
12	improves the learning experiences of students	4.87	0.41	High	Positive
13	improves the quality of the delivered education	4.79	0.25	High	Positive
14	increases the students' accuracy when doing tasks	4.53	0.63	High	Positive
15	increases the students' achievement	4.51	0.57	High	Positive
16	increases the students' engagement in the learning process	4.83	0.44	High	Positive
17	reduces the cognitive load on students	4.66	0.75	High	Positive
18	facilitates the process of learning abstract concepts	4.80	0.53	High	Positive
19	provides the students with an appropriate testing environment	4.92	0.50	High	Positive
20	eliminates the need for delivering face-to-face education	2.02	0.74	Low	Negative
Overall		4.51	0.49	High	Positive

Based on the table above, the overall mean is 4.51, which is high. This indicates that the sampled faculty members hold positive attitudes towards the use of virtual reality-based technologies in higher education institutions in the UAE. Thus, using such technologies has positive impacts on higher education. The latter result can be attributed to the fact that the use of any kind of technology for delivering education shall improve the delivered education and enable students to keep up with the latest knowledge, inventions, and advancements. Such use will transform the teaching-learning process into a modern one.

It was concluded that using virtual reality-based technologies promotes autonomous learning among students, because the mean of item (1) is 4.81. It was concluded that using virtual reality-based technologies makes learning more enjoyable, because the mean of item (2) is 4.76. It was concluded that using virtual reality-based technologies increases the students' motivation to learn, because the mean of item (3) is 4.88.

It was concluded that using virtual reality-based technologies increases students' attention, as indicated by the mean of item (4), which is 4.60. It was concluded that using virtual reality-based technologies improves the students' group collaboration skills, because the mean of item (5) is 4.73. It was concluded that using virtual reality-based technologies improves students' problem-solving skills, because the mean of item (6) is 4.54.

It was concluded that using virtual reality-based technologies improves the students' critical thinking skills, because the mean of item (7) is 4.63. It was concluded that using virtual reality-based technologies improves the students' decision-making skills, because the mean of item (8) is 4.50. It was concluded that using virtual reality-based technologies improves the students' leadership skills, because the mean of item (9) is 4.68. It was concluded that using virtual reality-based technologies promotes creativity among students, because the mean of item (11) is 4.55.

It was concluded that using virtual reality-based technologies improves students' learning experiences and the quality of the delivered education, as evidenced by the means of items (12) and (13), which are 4.87 and 4.79, respectively. It was concluded that using virtual reality-based technologies increases the students' accuracy when doing tasks, because the mean of item (14) is 4.53. It was concluded that using virtual reality-based technologies. It was concluded that using virtual reality-based technologies increases the students' achievement, because the mean of item (15) is 4.51.

It was concluded that using virtual reality-based technologies increases the students' engagement in the learning process, because the mean of item (16) is 4.83. It was concluded that using such technologies reduces the cognitive load on students, because the mean of item (17) is 4.66. It was found that using virtual reality-based technologies provides the students with an appropriate testing environment, because the mean of item (19) is 4.92.

Despite the aforementioned results, it was found that using virtual reality-based technologies cannot eliminate the need to deliver face-to-face education, because the mean of item (20) is 2.02. It was found that using virtual reality-based technologies plays a moderate role in developing students' social and communication skills because the mean of item (10) is 3.59.

4.2. Second Question

Q.2. What are the challenges hindering the use of virtual reality-based technologies in higher education institutions in the UAE?

Several challenges hinder the use of virtual reality-based technologies in higher education institutions in the UAE. Such challenges include facing difficulties in providing ongoing training to faculty members and students in the UAE. In this regard, five faculty members noted that ongoing training should be provided for both faculty members and students to enable them to utilize virtual learning programs effectively.

Other challenges include: facing difficulty in dedicating a high budget. In this regard, seven faculty members added that it is challenging to dedicate a high budget for delivering virtual education. One of them added that the costs of training students and faculty members are high. Another one of them added that the costs of purchasing the required software and programs are very high.

Other challenges in this regard include facing difficulty in developing specialized electronic learning materials. In this regard, three faculty members noted that it is challenging to develop specialized electronic learning materials that are rich in interesting multimedia and interactive elements. Other challenges in this regard include: facing difficulties in finding a strong internet connection for all students at home. In this regard, four faculty members added that it is challenging to oblige all students to have a strong internet connection at home. One of them added that some students suffer from poverty, which forces them to use the internet at low speeds.

Other challenges in this regard include the time-consuming nature of virtual learning activities. In fact, three faculty members added that virtual learning activities are time-consuming. That shall hinder instructors from covering the whole targeted material.

4.3. Third Question

Q.3. What suggestions can be offered to handle such challenges?

The sampled interviewees provided several suggestions for addressing the challenges, as listed below. For instance, five faculty members recommended providing faculty members and students with ongoing training about the use of virtual learning applications and programs. This will enable them to handle any technical problems they might face.

Seven faculty members recommended that universities allocate a high budget for providing students with training, hardware, software, and resources. In addition, three faculty members recommended developing special electronic learning materials and curricula that are full of interesting multimedia and interactive items.

In addition, four faculty members recommended concluding a contract with reliable telecommunication companies to provide all students with a strong internet connection at their homes. Furthermore, three faculty members recommended developing a time schedule by faculty members for conducting virtual learning activities to avoid wasting time and effort. In this way, all activities shall be planned. This will enable instructors to cover the entire targeted material during the semester.

5. Discussion

5.1. First Question

Q.1. What are the faculty members' attitudes towards the use of virtual reality-based technologies in higher education institutions in the UAE?

The respondents have positive attitudes towards using virtual reality-based technologies in higher education institutions in the UAE. This result may be attributed to the fact that such technologies offer access to an unlimited number of books, studies, encyclopedias, and knowledge. This can be attributed to the ability of such technologies to categorize and summarize information within a short period. It's consistent with the result reached by Al Harbi (2016). The latter researcher found that the faculty members' attitudes towards virtual learning environments (VLE) for teaching language studies in Saudi Arabian Universities are positive.

It was concluded that using virtual reality-based technologies promotes autonomous learning among students. The latter result is in agreement with the one concluded by Alfalah et al. (2018). It may be attributed to the fact that using virtual simulation models enables students to rely on themselves in examining phenomena, beings, and objects, and conducting virtual experiments. It was concluded that using virtual reality-based technologies makes learning more enjoyable. The latter result is in agreement with the one concluded by Alfalah et al. (2018). It may be attributed to the fact that such technologies allow students to see places and things they have never seen due to the high associated risk or lack of the needed resources.

It was concluded that the use of virtual reality-based technologies increases students' motivation to learn. The latter result is in agreement with the one concluded by Lin et al. (2017). It may be attributed to the fact that such technologies allow students to apply their knowledge virtually instead of acquiring knowledge through lecturing without applying it. It was concluded that using virtual reality-based technologies increases students' attention. The latter result is in agreement with the one concluded by problem Alfalah et al. (2018). Such technologies may engage students in a 360-degree learning experience that requires using the vision and hearing senses and exploring things.

It was concluded that using virtual reality-based technologies improves the students' group collaboration skills. The latter result is in agreement with the one concluded by Chen et al. (2022). Such technologies offer students many opportunities to work in groups. It was concluded that using virtual reality-based technologies improves students' problem-solving skills. The latter result is in agreement with the one concluded by Chen et al. (2022). This may be attributed to the fact that such technologies enable instructors to present virtual problems to students, allowing them to generate several potential solutions.

It was concluded that the use of virtual reality-based technologies improves students' critical thinking skills. The latter result is in agreement with the one concluded by Chen et al. (2022) and Jans

et al. (2023). This may be attributed to the fact that such technologies enable students to consider the finer details related to a phenomenon, object, or experiment. It was concluded that the use of virtual reality-based technologies improves students' decision-making skills. The latter result is in agreement with the one concluded by Jans et al. (2023). It may be attributed to the fact that such technologies allow students to analyze to decide which solution is the most effective.

It was concluded that using virtual reality-based technologies improves the students' leadership skills. The latter result is in agreement with the one concluded by Lin et al. (2017). Such technologies may offer students the opportunity to become the leader of a learning group. Practicing the leadership role shall contribute to improving the students' leadership skills. It was concluded that using virtual reality-based technologies promotes creativity among students. The latter result is in agreement with the one concluded by Lin et al. (2017). It may be attributed to the fact that such technologies allow students to see resources and things in nature that they have never seen before. That shall enable students to come up with novel solutions and ideas and develop new perspectives.

It was concluded that the use of virtual reality-based technologies enhances students' learning experiences and the quality of the education delivered. The latter result is in agreement with the one concluded by Samadbeik et al. (2018). It may be attributed to the fact that using such technologies allows students to engage in the learning experience by themselves and become active learners instead of relying on others to get knowledge through lecturing. It may be attributed to providing students with unlimited virtual resources and tools.

It was concluded that using virtual reality-based technologies enhances students' accuracy when performing tasks. The latter result is in agreement with the one concluded by Samadbeik et al. (2018). It may be attributed to the fact that such technologies provide students with opportunities to practice a skill several times till mastering it. It was concluded that using virtual reality-based technologies. It was concluded that using virtual reality-based technologies increases the students' achievement. The latter result is in agreement with the one concluded by Akman and Çakır (2020). That is because students who acquire knowledge visually shall retain it for a longer period in their minds. Thus, the students shall do well in exams.

It was concluded that the use of virtual reality-based technologies increases students' engagement in the learning process. The latter result is in agreement with the one concluded by Akman and Çakır (2020). It's attributed to the fact that such technologies allow students to acquire knowledge by themselves through observing and examining phenomena and objects in the virtual environment. It was concluded that using such technologies reduces the cognitive load on students. The latter result is in agreement with the one concluded by Liu et al. (2022). It may be attributed to the fact that illustrating knowledge visually reduces the amount of information that one's working memory must process within the specified time. That shall reduce the cognitive effort exerted by students.

It was found that using virtual reality-based technologies provides the students with an appropriate testing environment. The latter result is in agreement with the one concluded by Nersesian et al. (2019). It may be attributed to the fact that the virtual learning environment provides the students with much physical safety and all the needed resources (i.e., virtual equipment, materials, and patients) to do the assigned tasks on the tests.

Despite the aforementioned results, it was found that virtual reality-based technologies can't eliminate the need for face-to-face education. The latter result is in agreement with the one concluded by Hamad and Jia (2022). The latter result may be attributed to the fact that eliminating face-to-face education will negatively affect the development of students' personalities due to the absence of direct social interaction. Eliminating face-to-face education shall lead to providing the labour market with a labour force that has poor abilities to deal and interact with others socially.

It was found that using virtual reality-based technologies plays a moderate role in developing students' social and communication skills. The latter result is in disagreement with the one concluded by Hamad and Jia (2022). The latter result may be attributed to the fact that developing social skills requires engaging in face-to-face direct interaction and communication. Such development requires paying attention to people's gestures and body language.

5.2. Second Question

Q.2. What are the challenges hindering the use of virtual reality-based technologies in higher education institutions in the UAE?

There are several challenges that hinder the use of virtual reality-based technologies in higher education institutions in the UAE. Such challenges include: facing a difficulty in providing faculty members and students with ongoing training. This result is in agreement with the result of Hemme et al. (2023). It may be attributed to the difficulty of setting training plans.

Other challenges include: facing difficulty in dedicating a high budget. This result is in agreement with the result of Hemme et al. (2023). It may be attributed to the fact that virtual learning programs are very costly, and the salaries of the specialists in virtual learning are high.

Other challenges in this regard include: facing difficulties in developing special electronic learning materials. The latter result may be attributed to the need to recruit more IT specialists to develop such materials in collaboration with faculty members. Other challenges in this regard include the fact that it's time-consuming to do virtual learning activities. The latter result is in agreement with what's found by Agbele and Oyelade (2020). It may be attributed to the fact that doing such activities requires additional lectures, which are difficult to make.

5.3. Third Question

Q.3. What suggestions can be offered to handle such challenges?

The sampled interviewees offered several suggestions for handling the challenges. Such suggestions include: providing faculty members and students in the UAE with ongoing training about the use of virtual learning applications and programs. Such training shall enable faculty members and students to master the use of virtual technologies.

Other suggestions include: dedicating a high budget by the management of universities for providing students with all the training, hardware, software, and resources. That shall encourage and motivate students to use virtual technologies to learn. Other suggestions include: developing special electronic learning materials and curricula that are full of interesting multimedia and interactive items. Having such materials is essential to engage in virtual learning.

Other suggestions include: concluding a contract with reliable telecommunication companies for providing all students with a strong internet connection at their homes. That requires setting plans for supporting the collaboration between universities and telecommunication companies. Other suggestions include: developing a time schedule by faculty members for carrying out virtual learning activities to avoid waste of time and effort. That must be done by faculty members in collaboration with experts in curricula and teaching methods.

6. Conclusion

After analyzing data, it was found that using virtual reality-based technologies in higher education institutions in the UAE has positive impacts on higher education. The respondents have positive attitudes towards using virtual reality-based technologies in higher education institutions in the UAE. It was found that using such technologies improves the students' group collaboration, problem-solving, critical thinking, decision-making, and leadership skills. Such use also promotes

creativity and autonomous learning among students. It also makes learning more enjoyable and increases students' motivation and attention.

In terms of the challenges hindering the use of such technologies, they include: difficulty in providing faculty members and students with ongoing training about the way of using virtual learning programs and applications. They include the need for Emirati universities to dedicate a high budget to cover the costs of resources and training. They include facing a difficulty in finding a strong internet connection for all students at their homes due to poor internet availability.

7. Suggestions

The researchers recommend

- Providing faculty members in Emirati universities with training courses about virtual reality and its technologies.
- Passing pamphlets to faculty members in Emirati universities with the aim of promoting awareness about the advantages of using virtual reality-based technologies.
- Dedicating a special budget by the management of Emirati universities to use virtual reality-based technologies for delivering education.

Declarations

Author Contributions.

Saada Khadragy: She wrote the literature review, survey design, and edited the manuscript. She wrote the results, discussion, and conclusion.

Nadeen Selim: She collected data, conducted a qualitative analysis, and interviewed the faculty members.

Dalia Hassan: She chose the design and wrote the part entitled methodology.

Samira Setoutah: She drafted the theoretical framework and interpreted data.

Osama Abdelbary conducted a statistical analysis and verified the reliability and validity. He wrote the part entitled (suggestions)

All authors have read and approved the final version of the article.

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Ethical Approval. The respondents were informed about the goals of the study before providing the researchers with data about their views. They were informed that the data shall remain confidential and be used for meeting research-related goals.

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