Need Analysis for Higher Educational Institutions for Using Virtual Reality-TESLA Project

Staff Willingness and Readiness for Using VR in Teaching

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Ahmed Ewais[1,2(✉)], Zein Salah[3], Ghadeer Hamed[4]
[1]Arab American University, Jenin, Palestine
[2]WISE Lab, Vrije Universiteit Brussel, Brussels, Belgium
[3]Palestine Polytechnic University, Hebron, Palestine
[4]Birzeit University, Birzeit, Palestine
aewais@aaup.edu

Abstract—Recently, different solutions were proposed in literature to investigate the use of virtual reality in educational context. This is referred to the fact that virtual reality showed some interesting benefits over classical learning materials. This paper shows a study that was carried out in the context of TESLA Erasmus+ project to investigate both willingness and readiness of staff members in Palestinian partners. A questionnaire was distributed, and data were gathered from a sample of 100 staff members from four Palestinian HEIs who are involved in the project. The results are discussed, and some recommendations are given. Among the important results, the instructors' attitude is positive. However, they need to improve their skills in terms of techno-pedagogical aspects in virtual reality.

Keywords—needs analysis, virtual reality, Erasmus + project, education in HEIs

1 Introduction

The Palestinian Ministry of Higher Education and Scientific Research (MoHESR) is paying attention to 21st century skills, student-centered learning, and creativity [1]. Furthermore, among the defined priorities in the published Education Sector Strategic Plan for 2017–2022 is improving the quality of education by primary and secondary modernization, e-learning programs development and staff training [1]. Therefore, a need for incorporating recent ICT technologies such as Virtual Reality (VR) in the context of education to achieve a number of defined priorities in the strategic plan.

Similarly, the Palestinian Ministry of Education (MoE), who holds responsibility for managing public schools (Elementary and Secondary Schools), supported science teachers by training and supporting them to implement activities using emerging technologies and new tech trends in science education such as VR and AR. Therefore, it is confirmed in [2] that some public and private schools started to use emerging technologies such as simulation, VR, AR, Artificial Intelligence, etc. to teach science concepts in labs related to chemistry, physics, biology.

However, the use of VR is still remained a relatively small niche in Higher Educational Institutions (HEIs), private and public schools in Palestine despite the widespread of different hardware and software applications that facilitate the adoption of this technology. Also, there are no studies that were published during previous couple of years to investigate the need for using VR technology in HEIs or Primary Schools in Palestine.

Although, there are different research articles found in the literature body, presented different results concerning the staff and students' perception in using e-learning in HEIs and elementary and secondary schools [3]. Another study [4] investigated the perception of the use of e-learning from staff and students' perspectives. The study focused on usefulness, self-efficacy, willingness and challenges as indications of their ability and readiness to embrace e-learning. Even though results showed both staff and students have positive attitude towards the usefulness of e-learning, the results showed also the staff and students were not ready to adopt it. After almost 8 years (2018), almost every HEIs in Palestine are using e-learning to some extent [5]. Recently, after COVID19 pandemic, all HEIs in Palestine start using e-learning and distance learning.

Satisfying the previous mentioned needs, the need for adopting VR in educational contexts and improving collaboration between different universities, can be done by conducting the TESLA project which stands for TESLA – Virtual Reality as Innovative and Immersive Learning Tools for HEIs in Palestine [6]. The project is Erasmus Plus project funded by European Commission under the program Capacity building in the field of higher education. The project category is related to curriculum development as it falls in the national & cross-cutting priorities. In more details, the project is aiming at improving learning and teaching tools, methodologies and pedagogical approaches to improve curriculum of three courses related to Physics, Biology and Geographical Information System (GIS). More details about the instructional approach can be found in [7].

Moreover, the project outcome is to integrate VR in three main courses related to previous mentioned domains (Physics, Biology and GIS) to master related learning concepts. The three courses are selected because of the following reasons. First, Physics course was chosen to enable learners to visualize and simulate the different exercises that are related to newtons' law of motion without having a risk of damages. On the other hand, Biology-Forensic course was selected to enable students to approach, explore, visualize, take samples without defacing important evidences in crime scenes. Finally, GIS (geography and topography) course was chosen to enable students to get a good perception and 3D visualization for different terrain so that they can give interpretation based on what was given in the theoretical part of the course. The previous mentioned courses are offered by all Palestinian partners who participated in different activities that are related to training workshops, development of VR learning materials for the three courses, dissemination activities, etc. It is important to mention that all Palestinian partners offer the previous mentioned courses in different bachelor programs. More details about the project activities, tasks, challenges, etc. can be found in [6].

The purpose of this study is to investigate the instructor needs of using VR in teaching. The study is considered as one of the initial phases in the preparation work package for TESLA project. This step was conducted before starting the process of training

instructors to use VR solutions to find out their readiness, perception of utilizing VR and the different obstacles that instructors might face to adopt the use of VR technology in educational context. Accordingly, the capacity building phase of the project will be adjusted and customized based on the results of this study. The results will be used in designing VR modules for a number of courses to facilitate integration of VR in teaching methods.

2 Literature review

This section gives a general overview about conducted projects that support collaboration between different EU HEIs and Palestinian HEIs from educational point of view. After that, it reviews a number of research work that have been conducted to show benefits of using VR in educational contexts.

There are already a number of initiatives and projects which aimed at support cooperation between Palestinian HEIs themselves and between Palestinian HEIs and regional and international HEIs. In general, most of initiatives and projects were funded in the context of PEACE, QIF, PFDP, Tempus, Erasmus+ and Horizon 2020. For instance, PEACE Program (Palestinian – European Academic Co-operation in Education) was established in 1992 to promote intellectual cooperation between 23 Palestinian universities and 54 European universities through facilitating access, transfer and adaptation of knowledge within and across borders. The main activities of the PEACE are exchange of staff and students, grants for Palestinian students and young academics to complete graduate studies abroad and academic projects aimed at enhancing teaching and research at Palestinian HEIs. Another interesting program is the Palestinian Faculty Development Program (PFDP) aimed at "increasing capacity within the higher education sector in the WB and GS, address long-term issues of reform in teaching and learning practices and promote an institutional culture of teaching and learning." [5]. Other program is the Quality Improvement Fund (QIF) to assist HEIs to improve different bachelor and master programs to satisfy the need of the international job's competencies, requirements and skills [5].

Among related projects, RUFO is a Tempus project which is interuniversity network for open and distance learning. One of the major project's objectives, besides increasing the cooperation between Palestinian and European HEIs, producing a number of learning materials that can be used as blended learning courses. Another related project is the Avicenna Virtual Campus which aims at sharing best practices and innovative pedagogical solutions between 15 Mediterranean HEIs including Palestine. Another project is Education to Work Transition Project funded by QIF to foster partnership between HEIs and business sector by improving undergraduate programs so that students will gain required knowledge, competencies and skills. A previous comprehensive review related to conducted projects in Palestine is given in [5].

Currently, awareness of using VR has grown rapidly across the HEIs in Palestine. For instance, there were a number of workshops, seminars, etc. targeting academic staff and students to explain the use of VR in educational contexts. Furthermore, different HEIs are teaching VR courses in multimedia related Bachelor programs. Furthermore, the Erasmus plus project so-called Serious Games: Pathway Within the Undergraduate IT

Programs (SAGE) with a budget of 1 million Euros aimed at enhancing the cooperation between EU HEIs and both Palestinian and Tunisian HEIs to develop 8 courses and cases studies using serious games to train students in different domains such as social, health, education, etc. Another interesting project is OpenMed [8], whose main goal is to share knowledge to different target users such as people with disabilities, low-income people, etc. by adopting the use of open educational resources (OER) and open educational practices (OEP). Finally, another related Erasmus+ project is modernization of teaching methodologies in higher education: EU experience for Jordan and Palestine (METHODS). The project provided a solution for sharing best practices in ICT in education as it aims at improving the incorporation between technological tools and pedagogical aspects design, develop and evaluate e-curricula for open access portal.

Concerning the research work, research [9] showed the impact of different variables such as education levels, language skills, and target language. It indicated that VR technology can be beneficial to improve language learning as an educational resource. Other researchers showed different frameworks of using VR in teaching [10]–[12]. Also, some research was conducted in Palestine showed interest in integrating VR in educational domain. For instance, work presented in [13] proposed the use of VR for students who learn Anatomy course for medical students. It utilized a number of adaptation techniques to assist students during their learning inside the VR Anatomy course.

Recently, the use of VR technology in educational context has been recently fostered by different initiatives in Palestine. The initiatives are related to individual research work from academic staff and researchers in Palestinian HEIs. Other initiatives were conducted by IT hubs, Techno Parks, and e-learning centers that are owned by HEIs or business companies.

3 Method

This section shows the research questions that were formulated to achieve the research goal. After that, research instruments that was adopted to conduct this study is explained. Then, general information about the participants is presented. Finally, data analysis principles are explained.

3.1 Research questions

As mentioned earlier, the purpose of this study is to investigate the instructor needs of using VR in teaching. Therefore, the following research questions guided the study:

1. What is instructor's attitude of utilizing VR in teaching?
2. What is instructors' experience of using VR in teaching?
3. What is the readiness of IT infrastructure in HEIs partners?

To be able to answer the previous formulated research questions, a quantitative approach was employed using descriptive statistics.

3.2 Research instrument

The online questionnaire was designed based on the literature review [14], [15] and it was translated to Arabic language to avoid misunderstanding for some important concepts in the questionnaire (i.e., the questions were displayed in both languages Arabic and English). The validity of the developed questionnaire was checked by experts from the involved Palestinian universities and European partners in the project. The questionnaire was distributed electronically to instructors and they were given two weeks as a deadline to submit their answers.

The questionnaire consisted of three sections. First section was designed to collect the demographic and the scientific background for the instructors. Second section was designed to address the instructors' experiences and their attitude toward utilizing VR in education. Third section was used to collect data concerning the IT infrastructure in HIEs in Palestine. Also, the questionnaire was composed of 28 close-ended questions answered using a Likert scale of five points (where (1) Strongly Disagree, (2) Disagree, (3) Neither agree nor disagree, (4) Agree, (5) Strongly Agree).

To have an objective and critical evaluation results, a number of scientific steps were conducted to avoid bias. For instance, it was mentioned that there are no correct or wrong answers. Furthermore, it was explicitly mentioned that there is no need to mention the name of the instructors or their ID to make sure that the evaluation will be done anonymously. Also, negative formulated questions and positive formulated questions were adopted to avoid receiving more favorable results from participants [16]. Any contradictory answers to the negative formulated questions and positive formulated questions led to disregarding that evaluation form.

3.3 Participants demographic data

The online questionnaire was sent to staff members from the involved Palestinian universities in Tesla project (Namely: Al-Istiqlal, Al Quds Open University, Polytechnique Palestine University and Arab American University). Therefore, emails were sent to instructors in the departments asking them to fill in the online questionnaire after following the protocols in each university. A reminder email was sent to the instructors after one week of sending the first email. It is important to mention that the instructors were not obligated to participate in the questionnaire, and it was mentioned that the responses will be recorded anonymously. This was done to have objective evaluation.

A total number of 100 academics from the four Palestinian institutions responded to the instructors' questionnaire. The set of participants, as shown in Figure 1, includes instructors of different academic qualifications. For instance, the majority were PhD holders (55 %), 41% master's degree Holders, 4% Bachelor Degree who were lab supervisors. Regarding the specializations, the participants from human sciences (58%) were slightly more than participants from applied science disciplines (as it is depicted in Figure 2). Finally, Figure 3 shows the distribution of participating instructors according to their years of experience. For instance, 16.2% of participants have 1–3 years in teaching experience, 9.10% have taught 4–5 years, 23.20% have worked 6–10 years, 38.4% have experienced 10–20 years. and 13.10% have taught more than 20 years.

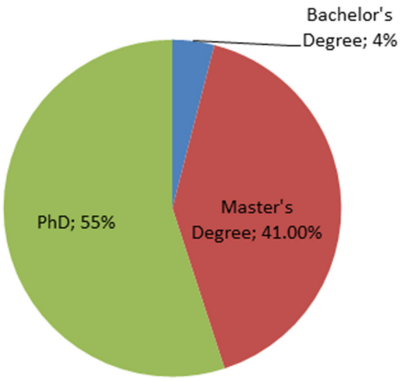

Fig. 1. Distribution of instructors' according of their academic qualifications

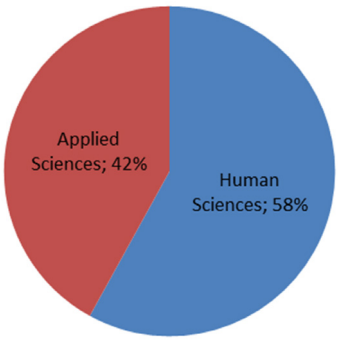

Fig. 2. Distribution of participants according to their specialization

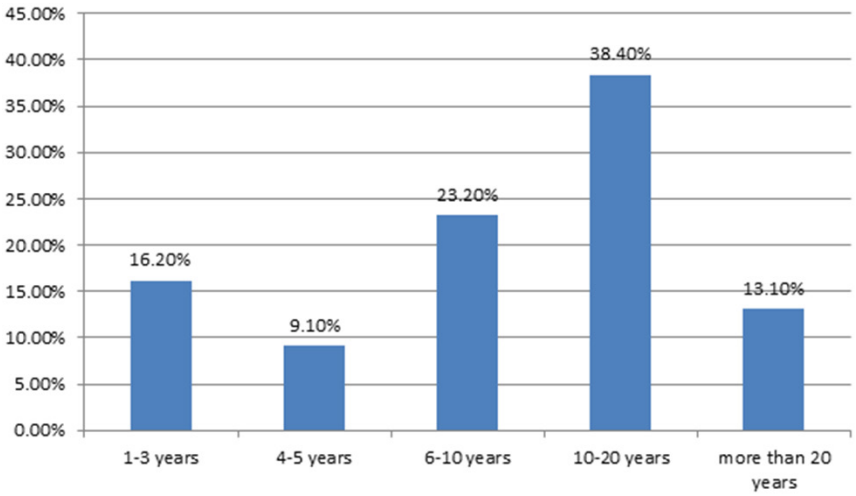

Fig. 3. Distribution of academics according to their years of expertise

3.4 Data analysis

To answer the research questions, the quantitative data was analyzed using SPSS for tabulating frequencies and descriptive statistics. The descriptive statistics includes both mean and standard deviation for each statement. To be able to analyze the obtained results, data analysis principles are considered.

As shown in Table 1, the scales that were considered as Highly Acceptable feedback are those who have average range from 4.21–5.00 while average results that range from 3.41–4.20 were considered as Acceptable feedback. Also, average results that range from 2.61–3.40 were considered as Neutral. Furthermore, average results ranging from 1.81–2.60 were considered as Hardly Acceptable feedback. Finally, average results ranging from 1.00–1.80 were considered as Not Acceptable. It is important to mention that the aforementioned protocol needs to be considered reversed for negatively formulated questions. Therefore, the less the average means the more positive results.

Table 1. Adopted verbal interpretation for average results

	Interpretation	**Ranges**
For Positive Formulated Statements	Highly Acceptable	4.21–5.00
	Acceptable	3.41–4.20
	Neutral	2.61–3.40
	Hardly Acceptable	1.81–2.60
	Not Acceptable	1.00–1.80
For Negative Formulated Statements	Highly Acceptable	1.00–1.80
	Acceptable	1.81–2.60
	Neutral	2.61–3.40
	Hardly Acceptable	3.41–4.20
	Not Acceptable	4.21–5.00

4 Results

In this section, we first present a summary of the obtained results. An analysis of these results follows in the subsequent sections.

Table 2 shows an overview of the number of statements that were rated according to the adopted interpretation. For instance, statements that were related to the instructors' attitudes toward the use of VR in education have 13 Acceptable results and one Neutral results. Concerning the statements related to current instructors' experience in using VR in educational context, three statements were rated as Acceptable and two were rated as Neutral. Also, two statements related to the current technological infrastructure were rated as Neutral and two statements related to current technical skills for instructors were rated as Acceptable. Making a deeper insight in the obtained results of the instructors' questionnaire, the results were summarized in the following subsections.

Table 2. Summary of questionnaire results

Category	Highly Acceptable	Acceptable	Neutral	Hardly Acceptable	Not Acceptable	Total
Attitudes toward employing VR in teaching	0	13	1	0	0	14
Experience of using VR in education	0	3	2	0	0	5
Technological infrastructure in the Palestinian universities	0	0	2	0	0	2
Technical skills for Instructors in using VR	0	2	0	0	0	2

4.1 Attitude toward employing VR in teaching

According to the results shown in Table 3, statements from 1-"I think virtual reality will improve my teaching methods." to 13-"Using gamification in the virtual environment helps student to understand the lesson better." were rated as positive results. Statement 14 "*It is difficult to evaluate student learning using the virtual environment*." was rated as neutral. As depicted in Figure 4, 82% respondents thought that VR will help them in teaching with new methods. Furthermore, 88% respondents agreed on the statement "VR will support 21st century skills". In addition, 79% respondents agreed that VR will improve the student's perception and 77% respondents realize that VR will enhance the interaction. However, more than 65% respondents stated that VR will motivate students in learning and strengthening the link between the theoretical and experimental knowledge. Moreover, 87% respondents considered VR as more flexible than traditional learning. However, 56% respondents expected that students will use VR easily.

Table 3. Instructors' attitudes toward utilizing VR in education

#	Statement	Mean	Std. Dev.	Interpretation
1	I think virtual reality will improve my teaching methods.	3.99	0.763	Acceptable
2	I think virtual reality will support 21st century skills for students.	4.19	0.837	Acceptable
3	I think that virtual reality will improve the students' perception.	3.99	0.859	Acceptable
4	Virtual reality will enhance interaction of the students with their instructor.	3.89	0.807	Acceptable
5	Virtual reality will motivate students to learn.	3.98	0.681	Acceptable
6	Virtual reality will strengthen the link between theoretical and experimental knowledge.	4.02	0.769	Acceptable
7	Virtual reality is more flexible in time and place.	4.08	0.713	Acceptable
8	I think the students will use virtual reality easily.	3.52	0.834	Acceptable
9	Virtual reality might cause a confusion of ideas.	2.36	0.905	Acceptable
10	I prefer that virtual reality will be an environment for students to use simulation.	3.86	0.603	Acceptable
11	Virtual reality contributes to students' communication skills.	3.85	0.734	Acceptable
12	Using problem-solving methods in VR will help students to understand the lesson better.	3.99	0.674	Acceptable
13	Using gamification in the virtual environment helps student to understand the lesson better.	4.04	0.702	Acceptable
14	It is difficult to evaluate student learning using the virtual environment.	2.98	0.953	Neutral

Notes: Strongly agree=5, agree=4, neutral=3, disagree=2, strongly disagree=1.

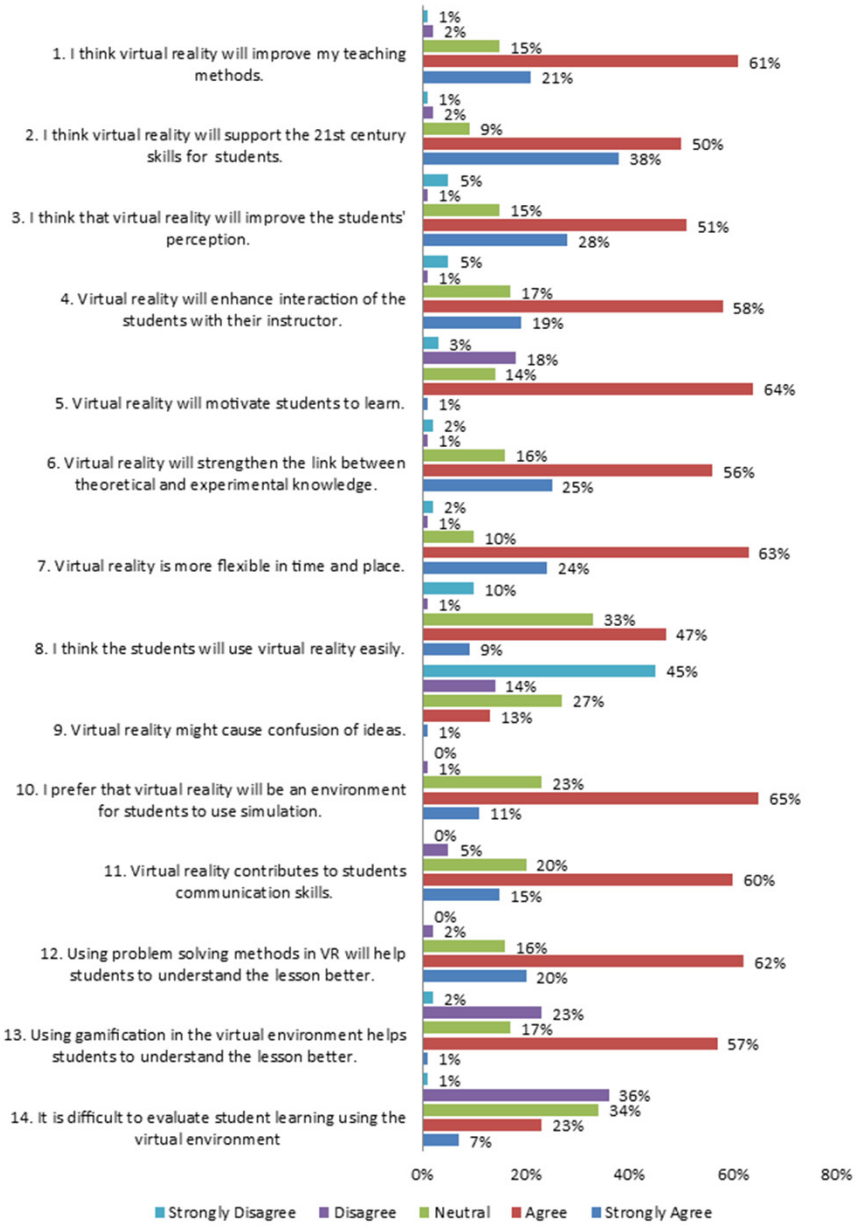

Fig. 4. Academics' attitudes toward utilizing VR in education

4.2 Diversity of VR experiences for instructors

Regarding the experience of Palestinian academics with VR, results depicted in Table 4 shows neutral results for both statements 1-"I have used virtual reality with students using different applications." and 2-"I know what virtual reality is and how

to use it in instruction, but I have concern using it." Whereas statements 3-"I Opening quotes realize the existence of virtual reality, but I don't recommend using it." 4-"I do know the difference in between virtual reality, augmented reality, and mixed reality", 5-"I don't have any idea about virtual reality." showed acceptable results. In more details, Figure 5 revealed that 55% of the academic already used VR in their teaching previously. In addition, 31% of them know about VR and how to use it, but they have some concerns about it. On the other hand, 13% of respondents realize the existence of VR but they do not recommend using it. Finally, there are 13% of respondents who have no idea about VR.

Table 4. Instructors' experiences of using VR in education

#	Statement	Mean	Std. Dev.	Interpretation
1	I have used virtual reality with students using different applications.	3.31	1.07	Neutral
2	I know what virtual reality is and how to use it in instruction, but I have concern using it.	2.82	1.09	Neutral
3	I realize the existence of virtual reality, but I don't recommend using it.	2.32	0.99	Acceptable
4	I do know the difference in between virtual reality, augmented reality, and mixed reality.	3.76	0.86	Acceptable
5	I don't have any idea about virtual reality.	2.04	1.04	Acceptable

Notes: Strongly agree=5, agree=4, neutral=3, disagree=2, strongly disagree=1.

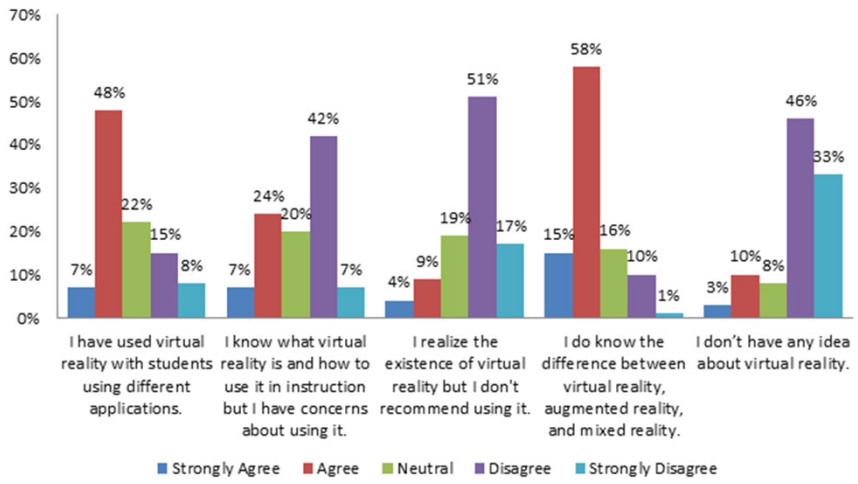

Fig. 5. Academics' experiences of using VR in education

4.3 Technological infrastructure in the Palestinian universities

Considering the technological infrastructure in the Palestinian universities, Table 5 showed neutral results for both statements 1-"There is no technically suitable hardware

for VR-based learning in university." and 2-"The internet network is not permanently available for use in university education." In Figure 6, 31% of respondents agreed that there is no suitable hardware for VR based learning in their universities, and 15% of them strongly agreed. In addition, the results indicated that internet services are available in the universities to some extent.

Table 5. The means and standard deviation of VR technological infrastructure

#	Statement	Mean	Std. Dev.	Interpretation
1	There is no technically suitable hardware for VR-based learning in university.	3.25	1.14	Neutral
2	The internet network is not permanently available for use in university education.	2.96	1.14	Neutral

Notes: Strongly agree=5, agree=4, neutral=3, disagree=2, strongly disagree=1.

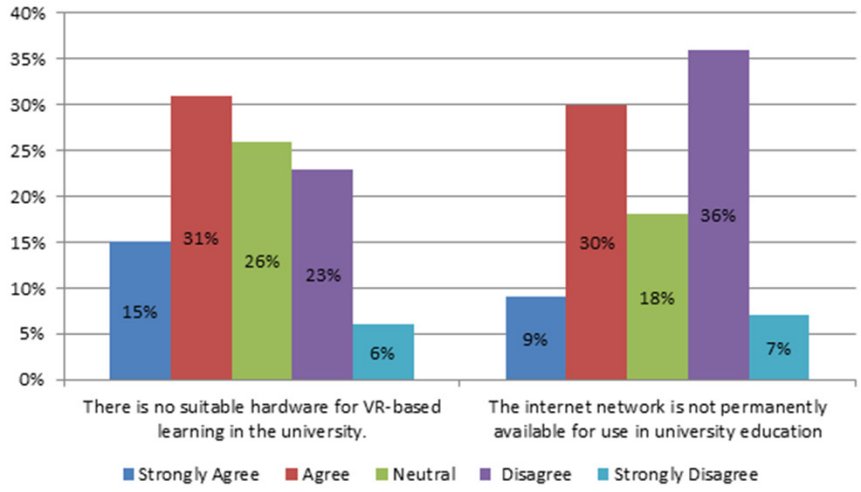

Fig. 6. Academics' responses of the technological infrastructure in Palestinian universities

4.4 Technical skills for instructors in using VR

Table 6 shows acceptable results concerning the current level of technical skills for instructors as displayed for both statements 1-"I feel irritable while using the virtual environment." and "I think virtual reality technology is difficult to use." Interestingly, Figure 7 shows that more than 55% of respondents agreed that VR technology is not difficult to use. However, 12% respondents stated that it is difficult, and 24% respondents were neutral. Moreover, more than 50% respondents showed that they do not feel irritable in using VR, and 30% respondents were neutral in this regard. Accordingly, it can be drawn out that Palestinian academics are in a relatively moderate level in term of VR technical skills.

Table 6. The mean and standard deviation of technical skills of academic

#	Statement	Mean	Std. Dev.	Interpretation
1	I feel irritable while using the virtual environment.	2.39	0.852	Acceptable
2	I think virtual reality technology is difficult to use.	2.39	0.827	Acceptable

Notes: Strongly agree=5, agree=4, neutral=3, disagree=2, strongly agree=1.

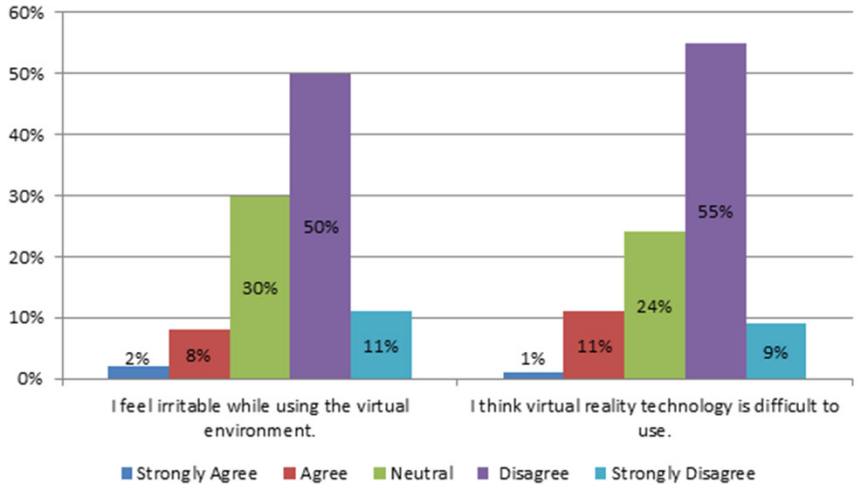

Fig. 7. Academics' responses of using VR technology

5 Discussion

Upon inspection of the results of this study, some academics still have concerns in implementing VR in education and learning and believe, e.g., that it is difficult to assess students in the VR learning environment. In general, the instructors have positive attitudes toward using VR in education. The instructors also believe that VR will support 21st century skills and enhance perception and understanding of the abstract concepts by using VR educational applications. They also agree that VR will improve the students' interaction and motivate students in such a way that is more flexible than traditional learning methods.

Despite previous positive attitudes, the results showed that there is a need to improve VR technical skills for instructors. The instructors need a training in how to use the VR in their teaching. This corresponded with the study [4], which showed even though staff have positive attitude towards the usefulness of e-learning, they were not ready to use it. Therefore, the researchers recommended to design and implement training for instructors, in terms of workshops and tutorials, to learn how to teach using VR and how to write effective instructional scenarios.

According to the results related to readiness of infrastructure in HEIs, it is clear that there is a lack of hardware compatible with integrating process of VR technology with courses from different programs. Thus, the researchers recommended to prepare a VR lab in each university for students and instructors with hardware compatible with VR technology and good internet connection. Such labs can have workstations compatible with VR technology, Head Mounted Devices, Sensors, etc.

Therefore, it is important for policy makers and regulatory bodies in Higher Education Institutions in Palestine to aware of the degree of readiness of HEIs in Palestine in order to adopt the use of virtual reality efficiently in different educational programs. Also, with the current lockdown under the pandemic of COVID-19 in Palestine and all over the world, all HEIs started to find possible solutions for delivering learning materials for practical courses and labs. Among the different possible solution, VR application would offer alternative solution to give a good chance to deliver 3D learning environments to increase interactivity in healthcare [17], and other domains.

6 Conclusion and future work

This article presents a study related to exploring the readiness of HEIs in Palestine in using VR technology for educational purposes. The analysis of quantitative data revealed a number of significant results. In particular, it can be concluded that instructors are willing to use VR technology in their teaching. Despite the fact that instructors' experience in using VR in education is little, their attitude towards the use of VR in their courses is positive. Furthermore, results revealed that technical and pedagogical skills for instructors related to integrating VR in their courses is moderate. Therefore, there is a need for staff capacity building in term of how to use VR in educational contexts in HEIs in Palestine.

Previous results are important as they provide first evidence for current status of using VR technology in HEIs in Palestine. Such results can be useful for policy makers in educational sector in Palestine to increase the awareness of the benefits of using VR technology in education. Such awareness can target administrative staff, faculty staff and students. Furthermore, considering the current lockdown due to COVID 19, VR technology offers an alternative solution to cover practical courses during the current adopted distance learning approach in HEIs.

This study has a number of limitations. For instance, the study was done in the Palestinian universities who are involved in the TESLA project. Other studies might include more Palestinian universities with different categorization (governmental, private, etc.). Other studies can be related to the readiness and awareness of the use of other technologies such as Augmented Reality, Mixed Reality.

In the future, similar study might be conducted for teachers in elementary schools to investigate the possibility of integrating VR technology in science, literature, etc. for pupils. This can be an input also for other projects that can target integrating VR technology in different courses curriculum in elementary and secondary schools.

Furthermore, it can be useful to conduct more studies that investigates the readiness and attitudes of the students in HEIs toward the use of VR in learning process. Such studies can reveal some aspects to be considered in the process of adopting VR

technology in HEIs. Other studies can be conducted to measure the achievements of the students before using VR and after using it in their learning.

Moreover, further needs assessment studies can be conducted by applying different measuring instruments related to qualitative tools such as interview, focusing groups, etc. Such studies might confirm some results obtained in this article or expose new aspects to identify the needs for VR.

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9 Authors

Ahmed Ewais is associate professor in Computer Science in Arab American University and researcher in Web & Information System Engineering (WISE) laboratory in Vrije Universiteit Brussel, Belgium. He is involved in a number of international projects related to Virtual Reality and Augmented Reality in educational contexts and his research is situated in the context of E-Learning, Massive Open Online Courses (MOOCs), Virtual Reality, Augmented Reality, Human Computer Interaction, UX&UI, Usability Evaluation. (email: aewais@aaup.edu, aewais@gmail.com)

Zein Salah has a PhD degree in natural sciences, with a specialization in computer graphics, from the University of Tübingen, Germany in 2006. He worked as a senior researcher for the University of Tübingen and later for the University of Magdeburg. He is a member of the German Association for Computer and Robotic Assisted Surgery. Since 2018, he is working as an assistant professor of computer science and engineering at Palestine Polytechnic University. His teaching and research interests include computer graphics, visualization, machine vision, and artificial intelligence. (email: zeinsalah@ppu.edu)

Ghadeer Hamed is a Research Assistant in Faculty of Education at Birzeit University, Palestine. A senior instructional designer for eLearning in Higher Education. Experienced with all stages of designing online courses, digital content, mLearning, and virtual reality. A trainer of eLearning and instructional design for instructors and students. Her research focuses on exploring the new trends in educational technology and pedagogy. She is currently a Middle East Professional Learning Initiative fellow (MEPLI 2022) at Harvard Graduate School of Education. (email: ghamed@birzeit.edu)

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