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Perceptions toward Adopting Virtual Reality as a Learning Aid in Information Technology

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***Abstract*—**The field of education is an ever-evolving area constantly enriched by newly discovered techniques provided by active research in all areas of technologies. The recent years have witnessed the introduction of a number of promising technologies and applications to enhance the teaching and learning experience. Virtual Reality (VR) applications are considered one of the evolving methods that have contributed to enhancing education in many fields. VR creates an artificial environment, using computer hardware and software, which is similar to the real world. This simulation provides a solution to improve the delivery of materials, which facilitates the teaching process by providing a useful aid to instructors, and enhances the learning experience by providing a beneficial learning aid. In order to assure future utilization of such systems, students' perceptions were examined toward utilizing VR as an educational tool in the Faculty of Information Technology (IT) in The University of Jordan. A questionnaire was administered to IT undergraduates investigating students' opinions about the potential opportunities that VR technology could offer and its implications as learning and teaching aid. The results confirmed the end users' willingness to adopt VR systems as a learning aid. The result of this research forms a solid base for investing in a VR system for IT education.

***Keywords*—**Education, information, technology, virtual reality.

I. Introduction

NOWADAYS, the continuous advance in the field of technology and specifically three-dimensional (3D) techniques along with the progress of related hardware and software facilitated the emergence of VR technology in various fields. VR systems afford exploration and manipulation of immersive 3D objects [1], [2] by replacing the real world with a virtual one through immersive multimedia techniques [3]. 3D models in Virtual Environments (VEs) provide better understanding for the objects, and this enabled VR to be part of several daily life activities, such as education, industrial applications as in engineering, entertainment, gaming, and in fields where safe training is required as in medicine and military [3].

Applications of VR swept into various contents, kinds of users (school and university students), and pedagogical aims (enhanced learning, teaching, training, rehabilitation, development of real life skills) [4]. However, although VEs facilitate the educational process in many fields, it should not be embedded in any educational system without assessing its impact on the system from different perspectives: a) Starting from the awareness of the users who will be involved (students and instructors); b) Users' acceptance of the new technology; c) Determining the educational situations and disciplines that require VR technology; d) Assessing the capability of VR systems to improve the students' learning outcomes.

This paper analyses the students' perceptions of VR systems as learning tools in information technology education and proposes a model for the implementation of educational VR system. In the next section, previous research presents the advantages of VR systems for the educational process. The third section presents the research methodology: proposed model, research methods, case study that examines the students' perceptions toward adopting VR systems in learning, and obtained results. In the fourth section, the proposal is justified from the perspective of the main findings of the study, besides comprising a summary of the main contributions of the outcome.

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II. Background

VR is "a technology designed to provide interaction between a user and artificially generated environments. This interaction is supposed to be more natural, direct, or real than pure simulation technologies or other previous technologies" [5]. The major target of VR is involving the user in the artificial environment, in order to invent the fantasy of being in an environment that can be comprehended as a realistic place with sufficient interactivity to carry out tasks in a proficient and comfortable way, whilst clarifying that there are two main stilts that illustrate the VR experience from the physical and psychological point of view: immersion and presence. The reason for using this type of technology is due to the fact that the users can simulate any aspect of the real world and experiment safely as the digital prototypes do not pose any hazard. Additionally, the VR environments offer the capacity of limitless repetitions for training purposes and they are non-distractive and time and cost efficient.

VR technology has been used in education to facilitate imparting knowledge and understanding as a learning aid along with traditional modalities in schools and colleges [6], [7]. VR has been elaborated in the field of education due to the positive outcomes that have been reported in science, engineering, business knowledge application, and anatomy learning [8]-[10]. However, VR might not work for all kinds of learning for different reasons: the suitability of content of the material to VE, learner characteristics, VR system effectiveness, users awareness of VR technology, and their

perceptions toward adapting it [11]-[13].

This study therefore aims to verify the users and specifically students' perceptions about embedding VR technology in education. The study intends to answer these questions: (1) What is the level of students' awareness about using technology in education? (2) What is the students' knowledge in VR technology? (3) To which extent are the students willing to use VR system as a learning medium?

III. Method

A. Framework

In this section, the architecture of examining the perceptions toward VR as a learning medium is described. This research will be a useful reference framework for designing and embedding VR in any pedagogical program as an educational technology. Fig. 1 shows the model proposed in this paper. The model was adopted from [4] and was modified to accommodate the purposes of this research, where:

User perceptions - The perceptions of the system users toward adopting VR technology as a learning medium: the first group of users "Students", and the second group of users "Instructors".

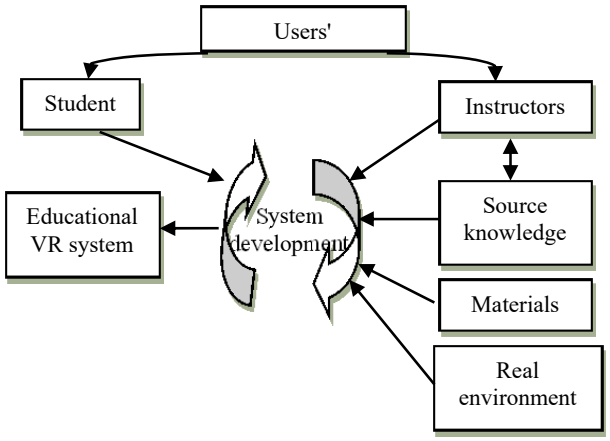

Fig. 1 Educational VR system model

Source knowledge - Represents all the concepts, skills, to be learnt by the student.

Real Environment - The setting in which teaching takes place.

Materials - Represent didactic materials and information related to the subject.

System Development - The actual implementation of the VR system.

Educational VR system - VR system for IT education as a learning medium.

One of the key questions before designing a VR learning system is to assess students' willingness to utilize the system. Obviously, it makes no sense to build such system, and users are not willing to adapt it. Therefore, this paper examines the first group of the system users' perceptions toward adapting VR technology as a learning medium.

B. Instrumentation

A questionnaire was completed online via a link that was sent to the students; the students volunteered to take part in the study and received no compensation for this. Total of 50 students completed the survey. The survey instrument included questions about the usage of technology in general and in education, particularly perceptions toward VR as a learning medium, and knowledge in VR. This questionnaire was based on previous studies' surveys [14]-[16]. However, for the purpose of this research, some questions from the original surveys were eliminated, others were amended, and some new questions were added.

C. Questionnaire Data Analysis

The quantitative data were analyzed using SPSS. The questionnaire consisted of 20 items (divided into the following categories: demographic, general attitude toward technology and VR, and knowledge in VR).

1. Participants

50 students at King Abdullah the Second School for Information Technology (KASIT) in the University of Jordan in Jordan participated in this study. Among the 50 students, 2% were in their first year, 2% in their second year, 46% in their third year, and 50% in their fourth year. 34% participants were male and 66% participants were female. The ages of the participants ranged from 18 to 26 years, with the majority (78%) between the ages of 18-22 years.

For the second group of questions about students' awareness and usage of technology and VR, Tables I-III show the obtained results.

In the fourth question in Table I, students were asked about the social computing applications that they use, students were asked to choose all the social computing applications that they use, and the majority of 48 students choose Facebook. In the sixth question, students were asked if they use technologies in learning in classroom, submitting assignments, communication with students and/or lecturers. A vast majority of 38% answered "Yes"; they use technology because they find them useful.

As shown in Table II, 86% of students had heard about VR technology but only 42% of them had used VR devices before (question 9). 86% of the students think that using VR technology in their course(s) is appropriate for the subject(s) that they learn (question 12). 92% of the students intend to use VR as a learning medium if it is implemented in their classrooms (question 13).

Cronbach's alpha for each factor is included in Tables III and IV along with the means and standard deviations of the sum variables. The results showed that Cronbach's alpha values were all above 0.7 (0.720 to 0.833), which indicates an acceptable internal consistency, and that the variables can be used to describe students' expectations [17].

TABLE I
RESULTS OF GENERAL QUESTIONS ABOUT TECHNOLOGY

Questions		Statements in the questionnaire or Answers	Frequency	Response percentage
Q4. Which social computing applications have you used? Please check all that you have used.	1.	Facebook	48	Only the frequency was calculated as students were allowed to choose more than answer
	2.	MySpace	4	
	3.	Wiki	17	
	4.	Blogs	9	
	5.	Twitter	23	
	6.	Multi-User VEs (such as Second Life)	2	
	7.	Massively Multiplayer Online Role Playing Games (such as World of Warcraft)	13	
	8.	Other	7	
	9.	None	0	
Q5. What courses are you enrolled in this semester? (Please give course names instead of course numbers).		Human computer interaction, Algorithms, Data structure, System analysis and design, Database, Advanced database, Multimedia, Distributed database, Image processing, Operating systems, Geographical Information systems, …		N/A
Q6. Do you use technologies in learning in classroom, submitting assignments, communication with students and/or lecturers, etc.	1.	Yes, because it is required	7	14.0
		Yes, because it is required Yes, because I find them useful	15	30.0
		Yes, because it is required Yes, because I find them useful Yes, because my colleagues use them	6	12.0
		Yes, because it is required Yes, because my colleagues use them	1	2.0
	2.	Yes, because I find them useful	19	38.0
	3.	Yes, because my colleagues use them	0	0
	4.	No, because it requires extra time for studying	0	0
	5.	No, because there is no support from instructors	2	4.0
	6.	No, because I don't know what might be useful	0	0
	7.	Other...	0	0
Q7. What technologies do you use (if there is any) in learning in classroom, submitting assignments, and communication with students and/or lecturers, etc.		e-learning, Facebook, PowerPoint, Laptop, Data show, Personal computer, Moodle, Internet, YouTube, Google,		N/A

TABLE II
RESULTS OF YES/NO QUESTIONS ABOUT TECHNOLOGY AND VR IN EDUCATION

Questions		Statements in the questionnaire or Answers	Frequency	Response percentage
Q8. Did you learn in any of the university courses about using technology in education?	1.	Yes	37	74.0
	2.	No	12	24.0
	3.	Other	1	2.0
Q9. Did you hear about VR technology before? (If not, please go back to the introduction to know what is VR)	1.	Yes	43	86.0
	2.	No	7	14.0
	3.	Other (Maybe)	0	0
Q10. Did you use any VR device before? (e.g. in Games)	1.	Yes	21	42
	2.	No	29	58
	3.	Other	0	0
Q11. Did you learn in any of the university courses about VR technology?	1.	Yes	24	48
	2.	No	21	42
	3.	Other (only this semester in Human Computer Interaction course)	5	10.0
Q12. Do you think using VR technology in your course(s) is appropriate for the subject(s) that you learn?	1.	Yes	43	86.0
	2.	No	7	14
	3.	Other	0	0
Q13. Do you think if VR technology is implemented as a learning medium you will use it in the classroom?	1.	Yes	46	92
	2.	No	4	8
	3.	Other	0	0

The results in Table III indicate that students' expectations of the importance of integrating technology in the teaching and learning process (M=4.52; SD=0.618) were quite high (question 14). Furthermore, respondents had quite high expectations with regard to learning efficiency when opportunities provided to interact with content and construct their own learning (M=4.27; SD=1.005) (question 15). Results also confirmed that students believe that virtual world technology provides an immersive learning environment where they can become engaged in the learning as they explore the VE (M=4.35; SD=0.911) (question 18).

TABLE III
RESULTS OF QUESTIONS ABOUT ATTITUDE TOWARD INTEGRATING VR INTO EDUCATIONAL PROCESS, QUESTIONS ADOPT THE FIVE-RATED LIKERT TYPE (1= STRONGLY DISAGREE, 2 = DISAGREE, 3 = NEUTRAL, 4 = AGREE, 5 = STRONGLY AGREE)

Questions	Mean	Std. Deviation	Cronbach's alpha
Q14. I think technology integration into teaching and learning is very important for students.	4.52	0.618	0.805
Q15. I think that I will learn most effectively when provided opportunities to interact with content and construct my own learning.	4.27	1.005	0.725
Q16. I am interested in learning how to incorporate VR technology into my learning.	4.44	0.897	0.768
Q17.I believe there are advantages to using VR technology in our course(s).	4.38	0.981	0.720
Q18. I believe that virtual world technology provides an immersive learning environment where students can become engaged in the learning as we explore the VE.	4.35	0.911	0.745

For the third group of questions (Table IV), which examines the knowledge of the respondents in VR, the majority of the respondents do not think that it is difficult to obtain a VR device (M=2.90; SD=1.057) (question 19). The results show that students' knowledge in regards to the benefits associated with the use of VR as a learning medium in IT education were moderately high (M=3.27; SD=.818) (question 20).

TABLE IV
RESULTS OF QUESTIONS ABOUT KNOWLEDGE IN VR, QUESTIONS ADOPT THE FIVE-RATED LIKERT TYPE (1= NOT AT ALL, 2 = SLIGHTLY, 3 = QUITE, 4 = VERY, 5 = EXTREMELY)

Questions	Mean	Std. Deviation	Cronbach's alpha
Q19. How difficult do you think it would be for you to obtain a VR device?	2.90	1.057	0.831
Q20. How knowledgeable do you consider yourself to be regarding the potential benefits associated with the potential use of VR in IT learning?	3.27	0.818	0.833

IV. DISCUSSION AND CONCLUDING REMARKS

This research aimed to provide a guidance model for adapting VR technology in the educational process. Furthermore, the research aimed to describe the expectations of IT students regarding VR as a learning medium, which is considered the first step in the educational VR system model, and their overall knowledge and experience with utilizing such technology. For this purpose, the questionnaire was adopted from previous similar studies and modified to achieve the goals of this research.

50 undergraduate students studying information technology completed the online questionnaire. Their responses were analyzed with questions being grouped into four parts to assess their attitudes, experiences, and expectations with regards to using social computer applications in general, using different types of technology application as part of the educational process for learning and communicating, and about virtual technology applications in specific as part of the learning process.

The first part revealed that all students had used some form of social computing application of which Facebook was the most frequently used one. The vast majority also used technology to complete assignments, submit work, and communicate with others, the most frequent justification for this being that students find the utilization of technology for these purposes useful. Only 4% of the questioned group of students did not use any technology to support the learning process, and when stating the reason for this, they responded that they felt a lack of support from instructors.

The second part showed that 74% of the students had learned about technology in education and 86% had heard about VR technology. 86% of respondents stated that they believed that VR applications would be appropriate for use in their courses and 92% stated that they would use such technology if it was made available to them; however, less than half had actually used VR technology before, and 42% had not formally learned about VR as part of their university courses.

In the third part, a five-rated Likert scale was employed to assess the students' attitudes towards employing technology in the learning and teaching process, opportunities for interacting with the learning content and constructing their own learning, and learning about the integration of VR into the educational process. Moreover, it assessed their thought whether implementation of VR technology provides advantages and provides an immersive environment that facilitates learning. All Cronbach's alpha values were above 0.7, which indicates positive attitudes and high expectations regarding the use of VR technology in the learning process.

The last section studied the students' knowledge about VR technology and showed that the majority did not think obtaining a VR device would be difficult, and generally that the students felt moderately knowledgeable about VR technology's potential benefits.

The students' attitudes and thoughts about VR technology in the learning process show a promising tendency towards accepting the utilization of this technology and its integration into the curriculum; therefore, this research paves the way for practical steps towards applying this technology in IT education. Similar evaluation from the point of view of the instructors will be carried out in the future to incorporate their perception into the design of any proposed solution.

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