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The Secondary School Student's Interest in Virtual Reality

Đorđe Đurković [1*], Veljko Aleksić [2]
[1] School of Economics and Trade, Kruševac, Serbia
[2] University of Kragujevac, Faculty of Technical Sciences Čačak, Serbia
[*] djurkovic.djordje93@gmail.com

Abstract: *Virtual technology can be of great benefit in modern education. The paper analyzes the advantages and disadvantages of using virtual reality in secondary education and examines students' interest in using virtual reality.*

Keywords: *virtual reality; secondary school*

1. INTRODUCTION

A definition often used for VR is "technology that convinces a participant that he or she is actually elsewhere by replacing the primary sensor input with the received data generated by the computer" [1][2]. One of the key elements of VR is the virtual world, that is, an imaginary space or a simulated environment. It is an illusion that illustrates a set of objects in the environment that fulfill the imagination of the creator. Along with the virtual world, there is also the "immersion" of VR, which is the perception that someone is in another world, like an imaginary world or another point of view of our world [3]. Immersion in VR is limited only by our imagination and how we decide to create a virtual world. The challenge of computer graphics is to make that virtual world look real, sound real, trigger and react to real-time interactions, and even feel real [4]4].

It was only in 2012 that virtual reality began to be noticed worldwide. The main reason for this is due to the extremely great success of the "Oculus VR" kickstarter company, where they managed to raise 2.4 million dollars. This led to the production of the Oculus Rift, a wearable and affordable HMD (head-mounted display) with stereoscopic displays that was considered comfortable and lightweight. One of the key features of the Rift is the ultrawide field of view (100 degrees) to create the immersion necessary to experience virtual reality. One of the main concerns that has arisen is whether the general public will adapt to VR HMDs, companies are developing integrated HMDs that require consumers to buy new hardware. The solution to this problem was triggered by a new VR trend that emerged in early 2014 where instead of that unknown technology, consumers would use the power of their phones. This was first demonstrated by Google with their Google cardboard HMD which could be used by a wide range of mobile devices. This solution is not without flaws, one of the main concerns regarding Google Cardboard is the fact that head tracking uses the phone's built-in accelerometer, this causes lag, headaches and nausea for many users. There are currently many other HMDs for mobile phones on the market. However, Samsung had the idea to enhance the wireless HMD experience that uses mobile phones as a platform. Oculus VR has developed Samsung Gear VR, it is a wireless HMD specifically for Samsung and their flagship phones like Galaxy Note 4 and Galaxy S6. It has an Oculus Rift head tracking module which drastically improves the screen response time compared to head movements. This reduces the chance of the user getting headaches and nausea. Just using the product to experience VR can cause unwanted consequences, however it is obvious that special care is taken to eliminate the cause of those consequences.

Virtual reality is often used for education in areas where real situations cannot be used due to lack of access or because it is too dangerous. One example is the U.S. Army's learning environment for basic corrosion prevention protection and control and the CAVE-based system for learning mandarin. Some papers analyze the impact on training students as they are immersed in an authentic environment. Bastiaens [5] reports VR-based experiments based on training for supply chain workers using different devices. Rahimian [6] reports on the use of VR for the professional training of architectural engineering specialists.

There are not many documented reports of virtual reality usage at the high school level. Several solutions used HMD, e.g. a system that assists teachers in classroom management [7] or haptic-enhanced simulation in physics. [8] A 3D interactive virtual chemistry laboratory was also

created [9]. Large number of papers were related to university education. In one instance the traditional projector was replaced by HMD which increased motivation and control over students during the lesson [10]. An intelligent learning environment has been developed and experimented with in several computer science subjects [11]. The immersive VR environment has been reported to support the design of architectural spatial experiences [12]. The avatar-filled VR system offers a training place for student interpretation [13]. The VR application visually presents neutrino data, intended for both students and researchers [14] while another VR system based on the CAVE system offers the possibility of experimenting the effect of relativity [15]. When it comes to university education and training for adults, the results show a significant percentage of reported documents in the medical fields. Here VR is widely used on very different levels. Starting from the education of a nurse in a common immersion system [16], medical training in a virtual hospital [17], medical training [18], simulated students to remove dental caries [19], a surgical education system that uses HMD and finger tracking to show practitioners the exact movements of expert fingers during surgery [20]. Research on the use of VR in medical training and education reports on the use of VR in supporting communication between medical staff, surgical simulations, pain management, several types of therapies, and rehabilitation interventions. VR is also used directly by patients for educational purposes (e.g., adult education for oral hygiene [21] or general health knowledge for adult education [22] and for rehabilitation purposes (e.g. VR-based therapy for vestibular problems [23] or breathing exercises in people with chronic obstructive pulmonary disease) [24]. It can also encourage communication between doctor and patient [24].

2. METHODOLOGY

One of the main problems in using virtual reality in education is students' interest in technology itself. Regardless of the efficiency and results that can be achieved using virtual reality in education, if students do not want to use it or are actively trying to avoid using it, these results will not be able to be practically achieved.

Research into the use of virtual reality in education has several possible problems. In this research, one of the important problems is the reaction of students to the virtual reality environment. VR is a relatively new technology because of this most students will encounter and use this technology for the first time. Some of the risks of using VR are nausea, disorientation and dizziness. In this experiment, several measures were taken to prevent these cases. All students were informed about possible side effects, because of this they were repeatedly informed that they were not obliged to participate in the experiment if they did not want to. A specific application that is not visually intensive and that does not move quickly was chosen, in order to reduce the risk of nausea and disorientation. Also, all students were in a sitting position, this minimizes the risk of injury in case of dizziness and disorientation. During the use, a researcher stood next to them from the beginning to the end of the ride, in case of any inconvenience, the students were told to close their eyes and say that they were uncomfortable. After each use, the glasses were wiped with a single-use alcohol wipe for disinfection.

In this experiment, the main subject of research is students' interest in using virtual reality technology for learning. The aim of the research is to find the level of students 'interest in using virtual reality technology for learning, to establish the difference between the experimental and control group and gender, to find the correlation of students' interest in using VR for learning and playing.

2.1. Hypotheses

In this experiment, several hypotheses were investigated:

H0 - Students who are interested in virtual reality technology in any form will have better dispositions of using it for learning.
H1 - Students with better results are more interested in using VR for learning.
H2 - Students who have used VR are more interested in using it in learning.
H3 - There is no difference in motivation depending on gender.

2.2. Sample

Two classes from the School of Economics and Trade in Kruševac participated in the experiment. Students can pick what course they want to take when they’re enrolling into the school, in this experiment students from the course of business administration have participated. In the first year we had 27 students willing to participate and in the second year 28 students, each year had a single class. Each class was divided into two groups, and each class was taught independently. There was a total of 55 participants, the control group had 29 participants and the experimental group 26, as shown in Table 1.

Table 1. *Participants by group type*

	I - year	**II - year**	**Number**	**Percentage**
Control	14	15	29	52,7%
Experimental	13	13	26	47,3%
Total			55	100%

2.3. Instrument and course of research

VR-BOX has been used as the main instrument in this experiment. VR-BOX is a HMD with lenses that use a mobile phone that's placed inside as a screen and the device on which the application is running. The mobile phone used is Samsung Galaxy A7 2018 with 6" screen and android operating system. The application used for the experiment is "VR Thrills" specifically "Steel runner" ride. The application and the ride were chosen for two main reasons:

1. Reducing the risk of nausea, disorientation and dizziness due to the use of VR – The roller coaster ride itself is not intense unlike other options.
2. Familiar subject matter - Students have either experienced a roller coaster ride in reality or are familiar with it, it also provides an opportunity to experience it in a safe environment.

The questionnaire contained seven demographic questions and six questions or statements related to virtual reality. Demographic questions were aimed at general information regarding students such as: Their gender, their age, what course are they participating in, where they grew up, their material status, average grades and average grade in the subject. The statements were mainly focused on students' opinions on using VR for studying, attractiveness for studying, how original the students find VR, playing games on VR, creating things for VR, ease of use. The Likert scale is used to establish students' opinions on questions or statements. The scale was from 1 (Very negative) to 5 (Very Positive).

The experiment lasted for two days; one department was done each day. Both groups had a computer science class on the same day. The first group was the control group. The control group filled out the questionnaire at the beginning of the class, they were only asked if they knew what virtual reality was to establish that they understood the topic of the questionnaire. Control groups understood the topic of the questionnaire and often compared virtual reality with 6D movies. The experimental group was first given the opportunity to test virtual reality before completing the questionnaire. After the obligatory explanation to the students about the possible undesirable side effects, each student was given a few minutes to go through the ride from the beginning to the end. Students are instructed not to communicate with each other until everyone has finished the ride and filled out the questionnaire. After all the students finished the ride and filled out the questionnaires, they were allowed to state what they thought.

3. RESULTS AND ANALYSIS

In Table 2 we see that for each question the average is greater than 3, this means that in general the participants expressed a little above the neutral answer to the questions asked. The participants had the most positive answer to the question related to the originality of virtual reality with an average of 4,05 and the least for the motivation to use it for studying with an average of 3,22. The highest degree of deviation has the question for creating virtual reality content with a deviation factor of 1,228, and the lowest deviation factor has the question for the originality of virtual reality with a deviation factor of 0,870.

Table 2. *Participants by group type*

Group statistics			
	N	**M**	**SD**
Using in studying	55	3,22	1,182
Attractive for studying	55	3,64	1,060
Original	55	4,05	0,870
Playing games	55	3,95	1,208
Creating	55	3,78	1,228
Ease of use	55	3,80	1,043

In the experiment, we had 12 male and 43 female participants as can be seen in Table 3. The highest average response for males was to use virtual reality to play games with an average of 4,25 and the lowest related to ease of use with an average of 3,58. The highest average response for women is for the originality of virtual reality with an average of 4,14 and the lowest for the motivation to use virtual reality for studying with an average of 3,16. The largest factor of male deviation is related to the issue of motivation in using virtual reality for learning with a deviation of 1,621, and the smallest is related to the issue of originality of virtual reality with a deviation of 1,357.

Table 3. *Answers grouped by gender*

Group Statistics					
Usage / Gender		N	M	SD	Std. Err. Mean
Studying	Male	12	3,42	1,621	0,468
	Female	43	3,16	1,045	0,159
Attractive for studying	Male	12	3,83	1,337	0,386
	Female	43	3,58	0,982	0,150
Original	Male	12	3,75	1,138	0,329
	Female	43	4,14	0,774	0,118
Playing games	Male	12	4,25	1,357	0,392
	Female	43	3,86	1,167	0,178
Creating	Male	12	4,08	1,240	0,358
	Female	43	3,70	1,225	0,187
Ease of use	Male	12	3,58	1,505	0,434
	Female	43	3,86	0,889	0,136

The largest female deviation is related to the issue of creating virtual reality content with a deviation of 1,225, and the smallest deviation factor is related to the issue of ease of use with a deviation factor of 0,889.

T-test analysis showed that we cannot reject the null hypothesis for any question. No statistically significant differences between the sexes were obtained with regard to the mentioned questions in the questionnaire. Thus, hypothesis 3 that there are no differences in motivation between the sexes cannot be rejected or confirmed. Sample is very unequally distributed among genders. The conclusions about this hypothesis could have significant limitations.

The control group had 29 participants and the experimental 26, as shown in Table 4. The biggest factor in the divergence of the control group was the issue of content creation in virtual reality with a deviation factor of 1,227, and the smallest was for the question of the originality of virtual reality with a factor of 0,926. The highest deviation factor for the experimental group is for the question of using virtual reality to play games with a deviation factor of 1,347, and the lowest is the same as for the control group for the question of originality with a deviation factor of 0.816.

Table 4. *Group statistics by group type*

Group Statistics					
Usage / Group type		N	M	SD	Std. Err. Mean
Studying	Control	29	3,38	1,178	0,219
	Experimental	26	3,04	1,183	0,232
Attractive for studying	Control	29	3,69	1,072	0,199
	Experimental	26	3,58	1,065	0,209
Original	Control	29	4,00	0,926	0,172
	Experimental	26	4,12	0,816	0,160
Playing games	Control	29	4,03	1,085	0,201
	Experimental	26	3,85	1,347	0,264
Creating	Control	29	3,83	1,227	0,228
	Experimental	26	3,73	1,251	0,245
Ease of use	Control	29	3,76	1,023	0,190
	Experimental	26	3,85	1,084	0,213

The results show that we cannot reject the null hypothesis for any of the questions. No statistically significant differences were obtained between the groups regarding the mentioned questions in the questionnaire, in no way can we claim that there are no average views between the control and experimental groups regarding the mentioned questions in the questionnaire. Thus, hypothesis 2 that students who have used virtual reality are more interested in using it for learning, unlike those who have not, we cannot confirm or reject it.

Table 5 shows the results of the correlation analysis. It can be observed that there are certain clearly defined correlations.

Table 5. *Correlation analysis*

		Material status	End of the year grade	Subject Grade	Using for studying	Original	Attractive for studying	Playing games	Creating	Ease of use
Material status	Pearson Corr.	1	0,152	-0,020	0,049	.332*	0,130	0,200	0,183	0,217
	Sig. (2-tailed)		0,268	0,891	0,720	0,013	0,343	0,143	0,182	0,112
End of the year grade	Pearson Corr.	0,152	1	.401**	0,001	.407**	0,221	-0,085	-0,112	0,193
	Sig. (2-	0,268		0,004	0,996	0,002	0,105	0,536	0,414	0,159
Subject Grade	Pearson Corr.	-0,020	.401**	1	0,255	0,157	.391**	0,015	-0,021	0,067
	Sig. (2-tailed)	0,891	0,004		0,074	0,275	0,005	0,917	0,885	0,645
Using for studying	Pearson Corr.	0,049	0,001	0,255	1	.367**	.700**	.411**	.404**	0,156
	Sig. (2-tailed)	0,720	0,996	0,074		0,006	0,000	0,002	0,002	0,255
Original	Pearson Corr.	.332*	.407**	0,157	.367**	1	.504**	.302*	.272*	.502**
	Sig. (2-	0,013	0,002	0,275	0,006		0,000	0,025	0,045	0,000
Attractive for studying	Pearson Corr.	0,130	0,221	.391**	.700**	.504**	1	.519**	.393**	.301*
	Sig. (2-	0,343	0,105	0,005	0,000	0,000		0,000	0,003	0,025
Playing games	Pearson Corr.	0,200	-0,085	0,015	.411**	.302*	.519**	1	.366**	.476**
	Sig. (2-	0,143	0,536	0,917	0,002	0,025	0,000		0,006	0,000
Creating	Pearson Corr.	0,183	-0,112	-0,021	.404**	.272*	.393**	.366**	1	.298*
	Sig. (2-tailed)	0,182	0,414	0,885	0,002	0,045	0,003	0,006		0,027
Ease of use	Pearson Corr.	0,217	0,193	0,067	0,156	.502**	.301*	.476**	.298*	1
	Sig. (2-tailed)	0,112	0,159	0,645	0,255	0,000	0,025	0,000	0,027	

Material status has a statistically significant correlation only on students' opinion of the originality of virtual reality.

Success at the end of the year has a statistically significant correlation on the grade from the subject and on the usefulness or attractiveness for learning using virtual reality. This indicates that students with better results find that virtual reality is more useful or attractive for studying compared to students with poorer results.

The grade from the subject has a statistically significant correlation with students' opinion on the usefulness or attractiveness of using virtual reality for studying, which further confirms hypothesis

number 1 that students with better success are more interested in using virtual reality for learning.

Motivation to use virtual reality for studying has a statistically significant correlation with students' opinions on the originality of virtual reality, usefulness or attractiveness for using virtual reality for learning, using virtual reality for playing games and creating content in virtual reality. From this it can be established that the motivation to use virtual reality is proportionally related to students' opinion about its originality, usefulness or attractiveness for studying, thinking about it as an environment for playing and creating content in it. Any positive or negative change in students' opinions on these questions / statements would directly affect their motivation to use virtual reality for learning.

Originality, usefulness or attractiveness for studying, the environment for playing and creating content in virtual reality have an essential statistical correlation. This confirms that any change in students 'opinions related to virtual reality in this context will proportionally directly affect students' motivation to use virtual reality for learning.

It can be said that the view of virtual reality is one whole, where the opinion about certain ways of using or aspects of virtual reality proportionally influences the opinion about its other aspects or way of using. Pedagogically, this allows us to approach students using different methods, i.e. we adjust them depending on the student. Positive thinking of students about virtual reality also increases their motivation to use virtual reality for learning.

With these results we can confirm the main hypothesis that students who are interested in virtual reality have a better disposition to use it for learning. The results indicate that the degree of interest of any aspect of virtual reality directly affects others.

4. CONCLUSION

Virtual reality provides the benefits of use in education, allows students to learn at their own pace, helps with permanent memorization of materials, facilitates understanding of abstract concepts, enables cheap testing of various designs, simulated environment with dangerous consequences in which students can work safely. However, the main obstacles for using VR, the concern of possible disruption in development of children, the necessary equipment and accompanying material specifically designed for subjects and additional education of teachers to use VR as a teaching tool effectively provide the challenge to implement VR as a traditional teaching tool.

There are multiple ways of expanding the research done in this paper further, obtaining a greater and more varied sample size would be one of the most straightforward ways. First step would be having a sample size for all 4 years of secondary school, we could expand that to multiple different secondary schools. Research in this paper has been done in an economic school there could be major differences in interest depending on the type of education students are doing. Research comparing secondary and university level interest also can be done to see if there's a difference depending on the level of education. If its established that there is significant interest across the different levels of educations tests regarding the effectiveness of VR can be done to establish at what level of education would using VR be most effective.

Virtual reality as a technology has advanced a lot in the past decade but the academic body of papers seems unable to keep up with this rapid development. VR can be applied in different areas of education however the main focus is on education in the university environment. It is accepted that VR is a good tool for university education and additional specializations. The works and experiments that focused on the second cycle of education had good results; it seems that the use of VR as an auxiliary tool is effective for younger students. During the second cycle of education, the use of VR increases students' interest in the subject as well as their results on knowledge tests. This aspect should be further examined as well as the analysis of the comparison of the effectiveness of VR on students of the second cycle of education with students at universities, due to the difference in the development, VR may have different efficiency depending on age. Currently, VR is not accepted as a traditional tool for use in education, with the advancement of technology, VR tools will be increasingly accessible, which could enable greater use of VR devices in education as well as easier use of students of these devices.

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