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The Impact of Training by Augmented Reality Technology on Creative Thinking and English-Language Learning Motivation of Students

Abstract

This study aims to investigate the impact of training by Augmented Reality technology (AR) on Creative Thinking (CT) and English language Learning Motivation (LM) among nine middle-school female students. The objective here is purely practical and a semi-experimental method is employed along with control and experimental groups. The case consisting of two groups of 30 people (test and control) were chosen by multi-stage cluster sampling method. AR technology was tested for English lesson learning for the test group, while conventional methods were provided for the control group. Data collection tools were used to collect data from A) the AR technology for the English lessons being held in 8 sessions of 60 minutes, B) Welch standard CT questionnaires, and C) the learning motivation, as propounded by Kashif et al. The statistical analysis results indicated that education by the AR technology had a positive and significant impact on the LM, especially on such components as learning facilities, family support and participation, peer influence, student personality, and student CT.

Keywords: Augmented Reality, Technology, Thinking, Learning Motivation.

Introduction

In recent years, since education needs modern methods to pervasively teach more and deeper subjects (Hosseini & Akbar Abadi, 2016), prompt technology advances and using technologies in the education fields, and also changes in the education system and lessons resources of elementary to high school make so many worries for the students and their parents about lack of sufficient knowledge of course content (Fallahi. M., 2020).

As regards major activities of the students do at home, if they have a question or they have difficulty learning something maybe parents can't help them and sometimes nevertheless they are trying to understand matter and help to their children, makes them more confused. One of keeping alive educational or research subjects in this situation is to relate them with new information and updated digital information such as AR (Fallahi. M., 2020).

AR merges the real-world elements with the allegorical cover. Studies indicate lack of real

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conditions outside the classroom on the way of train intercommunication English skills is a big preventive for learning the English language in countries where English is not the first language, AR technology can remove some of these constraints potentially by combining real and virtual content elements (Ashley-Welbeck & Vlachopoulos, 2020) as the inning the new technologies make major changings in the classroom that causes a change in educational structures, behavioral patterns within the education system, and even educational content (Zireh, M. Maghami, Gujar, & S, 2019).

Offered chances of AR technologies presented practical ways to meet the needs of teachers (Ozdemir, Sahin, Arcagok, & Demir, 2018). Using educational tools and they're being shown this fact that no more element of the teacher has emerged as the only power with the authority to teach. Traditional educational classrooms have no more effective because they depended on a special time and place and can not get the real texture and pertain to learning. Modern technologies accrete rich resources which can be an opportunity for learners to grow (Zireh et al., 2019). On the other hand, although some students naturally like to learn, many of them need to be encouraged for it. Effective learning in the classroom depends on the ability of teachers to stimulate lessons and discussions (Bakhsi, Mirjalili, Kazemi Zadeh, Iranmanesh, & r, 2018).

It is too important the tender and skills of the teachers to using of technologies like AR (Ashley-Welbeck & Vlachopoulos, 2020).

In the meantime, learning environments of AR with educational tools as AR included Innovative methods such as teamwork, CT, community-building semantics, and action-based learning can be effective in motivating learning. (Zireh et al., 2019) these tools are known by combinations of visual protects like images, modeling in the natural environment, and video modeling as Evidence-based methods have indicated positive impacts in learning promotion (Acar, Tekin-lftar, & Yikmis, 2017). This information combines in the form of text, image, video display in the physical world, and introduced with a direct and indirect show of the real-world which is added with virtual computer information and acted interactively (Jafarkhani & Jame buzorg, 2017).

Founded AR elements in several studies indicated that these tools can increase students' motivate participation and satisfaction during learning activities¹ (Ibanez, Di-Serio, Villaran-Molina, & Delgado-Kloos, 2015). The results of research by Redondo et al. (2020) show in the group that used AR augmented reality in learning English there are significant improvements in motivation, learning, and

socio-emotional relationships. So this technology type can present learning experiments that fit the preferences and needs of learners (Khateri, Pourroostaei Ardakani, & Zaraii Zavaraki, 2021).

Therefore training through this type of technologies includes a remarkable pleasure for the students because of the ability to control learners' learning, their independent access to information and focus. According to it, this is an effective factor in motivating students to learn, use information and communication technology in education today too (McMahon, Cihak, Wright, & Bell, 2016). Using AR by mobile phone for English learning was also welcomed (Zhang, Wang, & Wu, 2020). So it is an important goal of education to help students learn about how to think productively by combining high-level thinking (evaluating ideas) with CT (creating new ideas). New information and communicational technologies can be used to help most teachers and students to learn thinking skills and improve them. AR as a modern education technology is recognized by educational researchers (Zireh et al., 2019).

Therefore regarding mentioned topics, this study is going to answer this question: Does AR technology training affect CT and LM of female junior high school class one students?

Methodology

Participants and Context

The employed research method is a semi-experimental one with a pre-test post-test design including the control group. Statistical population for this study included 1100 high-school first-year female students in the academic year of 2020. Multi-stage cluster sampling method was used to choose two study groups: 30-people test group and a control group, among 60 students. The test group learned the given lessons in 8 sessions of 60 minutes using English language learning software based on AR.

Instrumentation and Data Collection

The Welch Creative Thinking Questionnaire (2002) included 20 items and aimed to assess CT skills of individuals. The questionnaire is characterized by the 5-point Likert scale that assigns 1, 2, 3, 4, and 5 to "None", "Rarely", "Sometimes", "Often", and "Always" options, respectively. All of the item scores were added up to obtain the overall score of the questionnaire items. Validity of the questionnaire was reported desirable in the Welch (2002) study and its reliability was also reported 93% by Welch (2002) via Cronbach's alpha coefficient. In addition, in the internal researches, reliability

was assessed by Samandarian (2009) to be higher than 80% according to Cronbach's alpha.

The LM Questionnaire was designed by and credited to Kashif et al. (2013) and it included 26 general questions. This 5D questionnaire assays the learning facilities, performances of professors, family support and participation, peer influence, and student personality; of note, the questionnaire is credited to Mahdipoor (2014). The answer spectrum is formed based on a 5-point Likert scale from a score of 5 (very high) to a score of 1 (very low). The scoring method functions by adding up the scores obtained from the above 26 phrases. The minimum and maximum possible scores were 26 and 130, respectively. The LM value is low, with the score ranging between 26 and 43. The LM value is medium with the score ranging between 43 and 68. The LM value is high, with a score higher

than 86. According to the study of Mahdipor (2014), the reliability of components for the whole questionnaire was measured at 0.81 using Cronbach's alpha method.

Data Analysis

For the transcribed data, descriptive statistics were computed. Multivariate covariance analysis using SPSS 24 software was employed to test the study hypotheses.

Findings

The main hypothesis: Education by the AR technology method has an effect on CT and LM of female high school students.

Table 1.

Box test results of investigating the assumption of homogeneity of dispersion matrix

Statistics index	Box Statistics	Statistics F	DF1	DF2	Sig
Groups	2.48	.91	3	605520	.43

As regards the value of $(p = 0.43, F(3, 605520) = 0.91)$, the homogeneity test of the scattering matrices is not significant.

Table 2.

Summary of the analysis of covariance information of research variables in the test and control groups for the mutual effect test

Group effect	Changes resource	Value of test statistics	F value	Freedom Degree from error	Degree of freedom of assumption	to be meaningful level
	Pillay effect	.87	193.19	2	55	.000
	Lambda-Wilkes	.12	193.19	2	55	.000
	The effect of Hoteling	7.02	193.19	2	55	.000
	The biggest root on	7.02	193.19	2	55	.000

Regarded as table 2 data and the Lambda-Wilkes test ($F(2, 55) = 0.12, p = 0.000$) as a result the hypothesis that the means of the two groups are similarly based on dependent

variables (CT and LM) is rejected; and the variance multivariable analysis is completely meaningful.

Table 3.

Summary of CT multivariable covariance and LM in the test and control groups

resource		Total squares	Degrees of freedom	Average squares	F	Sig	Squared Ata	Statistical power
CT	Pre-test	2.95	1	2.95	1.17	.28	.02	.18
	groups	68.09	1	68.09	26.98	.000	.32	.99
	error	141.30	56	2.25				
LM	Pre-test	5.77	1	5.77	1.47	.22	.02	.22
	groups	139.30	1	139.30	357.12	.000	.68	1
	error	218.48	56	3.90				

As shown in the above Table, AR technology has a significant effect at the 0.05 error level, controlling the pre-difference between CT averages and students' LM in the post-test stage. Thus, the main research hypothesis is confirmed. In other words, education by AR technology has a positive and significant effect on the CT and LM of high-school first-year female students. Also, the effect size of 0.32 indicates that a 32% improvement on the CT variable scores for the test group can be attributed to the effect of training with AR technology. Simply put, a 32% difference

between the variable CT scores for the test and control groups corresponds to the AR technology method. Also, the effect size of 0.86 indicates that 86% of the improvement on the LM variable scores for the experimental group can be attributed to the education by AR technology. Moreover, an 86% difference between the post-test scores of the LM variable for the experimental and control groups corresponds to the effect of AR technology method.

The first hypothesis: Education by the AR technology method has an effect on CT and LM of female grader students.

Table 4.

Summary of CT covariance analysis in the test and control groups

resource		Total squares	Degrees of freedom	Average squares	F	Level of being meaningful	Squared eta	Statistical power
CT	Pre-test	2.95	1	2.95	1.17	.28	.02	.18
	groups	68.09	1	68.09	26.98	.000	.32	.99
	Error	141.3	56	2.52				

As shown in the above Table, it has a meaningful effect in the error of 0/05 with control students CT means pre-different at post-test. So the first hypothesis is confirmed. In other words, education by AR technology has a meaningful and positive effect on the CT of female students in the first year of high school. The effect size of 0.32 also indicates can attribute 32% of score

improvements of the test group to the education by AR technology effect; That is 32% of the difference in the post-test scores of the CT variable of the test and control group are related to education by AR technology.

Second hypothesis: Education by AR technology has an effect on the high school female students LM.

Table 5.

Box test results to investigate assumption of dispersion matrix homogeneity

Statistics index	Statistics box	Statistics of F	Degree of freedom 1	Degree of freedom 2	Being meaningful level of
groups	12.23	1.28	15	135452.43	.20

Regarded as $(f 15, 13544/52) = 1.28$, $p=0.20$) value, the dispersion matrix homogeneity test is not meaningful.

Table 6.

Summary of LM items covariance analysis at the test and control groups to test the interaction

The group effect	Change resources	Test statistics value	F value	Degree of error freedom	Degree of freedom of assumption	Meaningful level
	Pillay effect	.91	105.97	5	49	.000
	Lambda-Wilkes	.081	105.97	5	49	.000
	Hotling effect	.081	105.97	5	49	.000
		.081	105.97	5	49	.000

As regarded table 6 data and the Lambda-Wilkes test value ($F(5, 49) = 0.08$, $P = 0.000$) the result is rejected the similarity of the means of the two groups based on the

dependent variables of LM components of students' hypothesis. The covariance multivariate analysis of LM components is quietly meaningful.

Table 7.

Summary of covariance multivariate analysis of LM components in the test and control groups

resource		Total squares	Degrees of freedom	Average squares	F	Meaningful level	The effect size	Statistics power
Learning facilities	Pre-test	1.68	1	1.68	1.63	.20	.03	.24
	groups	47.33	1	47.33	45.98	.000	.46	1
	error	54.54	53	54.54				
Performance	Pre-test	1.89	1	1.89	1.41	.23	.02	.21
	groups	.01	1	.01	.047	.93	.000	.051
	error	70.73	53	70.73				
Family support and participation	Pre-test	1.02	1	1.02	1.61	.20	.03	.31
	groups	59.87	1	59.87	94.83	.000	.64	1
	error	33.46	53	33.46				
Peer Pressure	Pre-test	.79	1	.79	1.25	.26	.02	.19
	groups	107.66	1	107.66	169.80	.000	.76	1
	error	33.60	53	33.60				
Student personality	Pre-test	.051	1	.051	.09	.76	.02	.06
	groups	96.74	1	96.74	171.48	.000	.76	1
	error	29.90	53	.56				

According to the above table, by the pre-test control, education by the AR technology has a significant effect on the LM components (learning facilities, family support and participation, peer influence, and student personality) at the 0.05 error level. Therefore, the second hypothesis is confirmed. In other words, education by AR technology affects the mentioned LM components. However, a significant level of the performance indicates that education by the AR technology does not affect the operation (the significant level is higher than the default value of 0.05).

The effect size of 0.46 illustrates that a 46% improvement on the learning facility scores for the test group could be attributed to the effect of AR technology method. It can be implied that a 46% difference between the post-test scores of learning facilities for test and control groups corresponds to the effect of AR technology method. The size of the effect equal to 0.64 indicates that a 50% improvement on the scores for the family support and participation component for the test group could be attributed to the effect of AR technology method. A 64% difference between family support and participation component scores for the post-test test and control groups is attributed to the AR technology method. The size of effect equal to

0.76 indicates that a 76% improvement on test group scores for the peer influence component could be attributed to the education effect of the AR technology method. It is implied that a 76% difference between the post-test scores of peer influence component for the test and control groups is related to the effect of AR technology method. The effect size equal to 0.76 indicates that a 76% improvement on the student personality scores for the test group could be attributed to the effect of the AR technology method. In other words, a 76% difference between the post-test scores of the student personality component for the test and control groups corresponds to the effect of AR technology method.

Discussions and Conclusion

The main hypothesis investigation: Education by the AR technology method affected the LM and CT of female high school students

Findings of this study hypothesis indicate that with pre-different CT and LM students means control in the post-test stage with 0.05 error level has a meaningful effect. Therefore the main hypothesis of the research is confirmed. In the other word, has a positive and meaningful education by the AR technology on female

students in the first year of high school LM and CT. Also, the effect size of 0.32 indicates that 32% of improved test group scores on the CT variable could be attributed to the effect of the AR technology method. That's it 32% difference in the post-test scores of test and control group CT variant related to education AR technology method .

Also, the effect size of 0.86 indicates that 76% of scores improvement of test group in LM variant could be attributed to education effect by AR technology method. That's it 86% of differences between test and control groups post-test scores of the LM variant are related to education by AR technology method. These findings have harmony with Varrostaee Ardakani et al (2017), Serami, Rasti, and Maher (2016), Faregh and Jafari Sisy (2020), Falahi (2020), Khateri et all (2020), Beaken et all (2016) Emilo Gonzalez Vargas, Fabregat and Carrillo-Ramos (2020) findings.

In explaining this research finding, it should be said the AR is one of the new learning technologies in science, educational technology. This technology supports advances in Educational Sciences and also advances in educational technology. This technology adds application and ideal properties to the environmental world and makes it complementarity in multiple dimensions. Therefore, since this is not possible to educate in the real environment, educational technologies and obviously the AR has the potential to present a proper learning experiment (Hosseini & Akbar Abadi, 2016). AR is the real world that a virtual world is added to it which is included in pictures, voices, etc. the AR can be considered as digital media information that assimilates the real world spatially and temporally, and it is interactive straightaway (Nowruzzi, Samani, & Lotfi, 2017). By using AR technology (such as Add computer vision and object recognition) information of the user's real-world will be interactive and can be manipulated digitally. According to this, this learning order can prepare the field of LM and CT gradations (Beckmann & Weber, 2016). In other words, the learning method through the combined reality became the most prevalent educational method, from the early twentieth century; by which, all of the learning and educational activations and processes like teaching, homework presentation, assessment, and all of the interactions between elements of the educational system is done. So many studies have been conducted about the role and effect of this tool in the teaching-learning process, which often indicates the positive function of the mentioned system in improving the quality of these processes. The studies of " Shin and Kang, 2015; Steiner, Gotz, and Stilitz 2013" have proven combined reality

effectiveness in the learning management system in encouraging active, learner-centered, and structuralist learning methods. That's why the specialists of electronic education combined type believe despite problems there are in this technology establishment and application and especially it is a time taking process problem, using this is an affordable way and can have a great effect in improving the learners CT and LM.

The study of first sub-hypothesis: education by AR technology has an effect on female high school students CT.

Findings from this research hypothesis showed by controlling pre-differences student CT means in the post-test stage, there is a meaningful effect at the error level of 0.05. Therefore, the first sub-hypothesis of the study is confirmed. In the other words, education by AR technology has a positive and meaningful effect on high school female students. Also, the effect size of 0.32 indicates 32% of the improving scores of the test group in the CT variant can be attributed to the effect of education by the AR method. That's it 32% difference between scores post-test CT variant of test and control group is related to Education by AR technology. This finding has harmony with Verrostaee Ardakani et al. (2017), Sarami, Rasti and Maher (2015), Bacon et al. (2016), Khan, Johnston, and Jacques et off (2019), Damla and Fazil (2017) findings.

In a statement of this finding can be said the education becomes an important tool that people tries to achieve in personal goals and results, and looking for a better life through it, therefore there is a need to build education in the learning style basis, and be planned based on achieving a specific goal, in order to increase the education quality. In general, must offer a chance while the learner can achieve individual skills, motivation management, and the ability to search and integrate information to solve a problem. In order to this, can use the last technology of today to improve and effective the executive programs to achieve the desired results (Siedi & Yaqubi, 2012). Indeed, emerging of new technologies like AR makes major changes in the classroom that it makes changes in educational structures, behavioral patterns within the education system, and even educational content (Zireh et al., 2019). Offered chances of these technologies presented practical ways for making come true teacher's needs (Ozdemir et al., 2018). Since information and communication technology can implement a potential role in student knowledge and skills by applying personalization to learning, a multi-sensory approach, and the ability to enhance interactions with content. In between, the AR technology ability and capacity in combining with the real world with virtual content offers modern methods to learning and

improving the current educations and turns the learning process into an interactive, multi-sensory, and enjoyable experiment (Zireh et al., 2019). So that quick development of these tools and their adjustments with human requirements creates interactive, active, and creative learning environments, and since traditional learning environment lose its spell to new generations, education by AR technology could make necessary curiosity and motivation to draw the attention of learners and made come to true a full of desire, attracting attention environment, so that teachers can go along technology intelligently, today and try to train a dynamic generation and active who make efforts according to their features and characteristics, and to present their CT improvement field.

The study of the second sub-hypothesis: education by AR technology approach has an effect on the female high school students.

The Studies of this hypothesis indicated that education by AR technology has a meaningful effect on the LM components (learning facilities, family support, and participation, peer influence, personality) at the error level of 0.05 with pre-test control. Therefore, the second hypothesis of the study is confirmed. In the other words, education by AR technology has an effect on LM components (learning facilities, family support, and participation, peer influence, personality). But, the meaningful being level in the function component indicates that education by AR technology has not an effect on the function component (meaningful level is higher than the defaulted value of 0.05). The effect size of 0.46 indicates that 46% of test group scores improvement in the learning facilities can be attributed to the effect of education by the AR technology method. That's it differences between post-test scores of test and control group learning facilities is related to education by AR technology method. The size effect of 0.64 indicates that 50% of the scores improving in the family support and participation component can be attributed in education by AR technology effect. That's it 64% of differences between test and control groups post-test scores are related to education by AR technology method. The size effect of 0.76 indicates that 76% of the scores improving in peer influences component can be attributed in education by AR technology method effect. That's it 64% of differences between test and control groups post-test scores of peer influences component are related to education by AR technology method. The size effect of 0.76 indicates that 76% of the scores improving in the student personality component can be attributed in education by the AR technology method effect.

That's it 64% of differences between test and control groups post-test scores of student

personality component are related to education by AR technology method. This study finding have harmony with Faregh and Jafari Sisy (2020), Fallahi (2020), Khateri et al. (2020), Rajabian Dehzireh et al. (2019), Camilo Gonzalez Vargas, Fabregat, and Carrillo-Ramos (2020), Khan, Johnston, and Jacques Ofoff (2019), Damla and Fazil (2017), Allo and Agomo (2016) findings.

In a statement, this study finding it should be said that education by AR technology includes innovative methods like group works, CT, build meaning through community, and learning through action witch can affect the LM (Zireh et al., 2019). These tools are with a combination of visual protections as pictures, modeling in the natural environment, and modeling as evidence-based practices that showed positive effects in improving the learning (Acar et al., 2017). These tools also combine the information in the text, picture, video show in the physical world formats, and with the direct or indirect representation of the real world will be added with virtual computer information, and operates interactively (Jafarkhani & Jame buzorg, 2017); The realization of this interaction between modern educational tools and the educational environment and learners can have an effect on the student's LM. In other words, the AR elements found in many types of research indicate these tools can increase the student's motivation, participation, and adhesion during learning activities (Ibanez et al., 2015). Therefore, this technology genre can offer learning experiments fit with the distinctions and requirements of the learner (Khateri et al., 2021). Therefore education through these technology genres, because of ability in learning control by learners, their independent achievement to the information and concentration and attention, has a remarkable pleasure for the students. According to this, today applying information, communication in education is one of the effective factors in creating LM of the students (McMahon et al., 2016).

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