THE IMPACT OF E-LEARNING ON UNIVERSITY STUDENTS' ACADEMIC ACHIEVEMENT AND CREATIVITY

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ABSTRACT

Research on the efficacy of ICT-based teaching methods in improving generic skills in addition to content skills among future workforce is increasing. Accordingly, this study investigates the impact of e-learning on creativity and content knowledge of chemistry students at the Payame Noor University of Hamedan, Iran. The study used the pre-test/post-test experimental design with a control group. The statistical population of the study included was 100 pure chemistry students who were following two separate classes. Forty students were selected from this group who placed in the experimental group (n = 20) and the control group (n = 20). Two instruments were used for data collection; a specifically developed test on the Introduction to Chemistry course and the Abedi Inventory for assessing creativity. Results of data analysis using the independent t-test (aided by SPSS) demonstrated statistically significantly higher scores for the experimental group on measured variables, knowledge and creativity. Therefore, it is concluded that e-learning is effective for knowledge and creativity acquisitions among chemistry students and the greater e-learning opportunities should be provided for wider audiences.

Keywords: E-learning, student's learning and creativity.

1.   INTRODUCTION

Information and communication technologies (ICT) provide new opportunities for education and training, as they enhance learning and teaching, and facilitate collaborations, innovation and creativity for individuals and organizations (Ala-Mutka, Punie & Redecker, 2008). Although often used as an extension of other teaching tools, the use of ICT has the potential to open opportunities of new ways of doing things, thus developing creativity in learning. Furthermore, ICT use has been found to be associated with creativity of Gorbi (2013). Thus, the use ICT can support development of public policy for educational change that promote creative and innovative school [and university] environment (Cachia, Ferrari & Punie, 2011).

Previous development model indicate that successful training of scientists require three elements namely, science content (focus), technology and vocational orientation (Lebeaume, 2004). The science content focuses on knowledge of discipline, while technology and vocational orientation help to improve the scientist's process skills. Higher education as the training ground for future scientists must make a big impact on university students' intellectual process, mental ability, learning skill and creativity so that they can proceed with critical and progressive thinking that enable them to provide solutions to current problems (Mahmoodi, Maleki & Sanisales, 2015). An education system that harmonizes with the changing world needs and has a fructuous look at the sciences will provide diverse training and learning experiences to support the learners' creativity and academic ability. In fact, such an education system is more able to provide better thinking skills and ability in learners as the system prepares them for better understanding of the world and the need for constructive innovations (Payne Young; 2009).

The application of teaching and learning methods that promotes deep and active learning and creativity in learners is the emphasis of the educational system of the present age. A number of scholars have suggested that there exists a strong relationship between learning and creativity and in fact Guilford (1950) states that creativity can be considered as a sub-type of learning (in sited by Truman, 2011, p: 1). Higher education, as a social institution must function according to the needs of the community, i.e., should nurture individuals that they educate to be creative and thoughtful with high academic ability. To achieve this objective, the traditional teaching methods (lectures, etc.) do not have the required effectiveness, but implementation of e-learning in teaching-learning process could be a way to realize this goal (Zare et al., 2014).

E-learning is one of the most important learning environments in the information era. Therefore, efforts and experiences related to this type of learning is given due attention around the world. In Iran, most universities are extensively using this technology. E-learning can benefit self-regulation through the use of self-directed e-learning. The purpose of the current study is to investigate the impact of self-directed e-learning on undergraduate students' achievement in a science course and creativity.

2.   LITERATURE REVIEW

2.1   E-Learning

E-learning is defined as a system based on technology, organization, and management which bestows upon the students the ability to learn via internet and facilitates their learning (Levy, 2006). E-learning makes use of telecommunications technology to get information to achieve

the teaching and learning objectives (Bowles, 2000). Also Wanting et al. (2000) define e-learning as acquisition of the disseminated knowledge using electronic devices. it can be said that e-learning refers to the use of systems of electronic education such as computer, internet, multimedia disks, electronic magazines, virtual newscasts, and etc. whose purposes are to reduce time and expenses and achieve better, faster, and easier learning (Zare et al, 2014). Employment of information and communication technologies in education has created a new mode of learning which does not require physical attendance; hence, learning has been made possible in environments other than classrooms (Gholamhosseini, 2008). In this context, some study is reviewed next.

Keshavarz et al. (2013) concluded that e-learning has a positive impact on academic achievements of students. ZarieZavaraki & Rezaei (2011) in their study at the e-learning center in Khaje Nasir Toosi University concludes found that the use of e-portfolio significantly improved students' attitude, motivation and academic achievement. Mahmoodi et al. (2015) found that the use of e-learning in physiology teaching-learning process improves students learning and creativity. Zare et al. (2015), also found that learning and recollection of students who were educated to multimedia methods, is more than learning and recollection of students who were educated in the traditional methods.

Review of studies conducted in the field of e-learning application and its impact on learning and creativity suggests that the use of this teaching method in the teaching-learning process can lead to the effectiveness of training. Emergence of new theories of teaching and learning has made the education to shift from being teacher-oriented to being student-oriented. Moreover, development and evolution of new communication devices has enabled modern man to use modern methods of teaching and learning and get free from time and space barriers and keep on learning in any time and place according to his needs and demands (Hosseini et al., 2015).

The use of electronic technologies has led to the development of educational opportunities and helps students develop their skills. According to studies, the evidence shows that e-learning can have a profound and positive impact on learners' involvement, positive attitudes of teachers, personalized learning, and learners' creativity (Magnoson et al., 2010). Negash & Wilcox (2008), quoted in Mahmoodi et al. (2015), suggest that there are six different types of e-learning. These six types are presented below:

i. E-learning with Physical Presence and without E-communication (face-to-face)
ii. E-learning without Presence and without E-communication (self-learning)
iii. E-learning without Presence and with E-communication (asynchronous)
iv. E-learning with virtual Presence and with E-communication (synchronous)
v. E-learning with occasional Presence and with E-communication (blended/hybrid-asynchronous)
vi. E-learning with Presence and with E-communication (blended/hybrid-synchronous)

Different types of e-learning methods have been proposed, but the present study focuses on the second type i.e. self-directed learning method of e-learning. In fact, this type of e-learning is the self-instruction of self-paced method of learning. In this method, the learners use the educational media and take responsibility of learning on their own.

2.2   Creativity

Creating the groundwork to achieve creative thinking and activate inclusive potential education intelligence is one of the main strategies of pervasive training in educational systems because inclusive intelligence will create its ideas based on interactions with the environment, manipulation of personal experiences and their revision by having access to this skill. Such a view in the area of information literacy leads to achieve effective learning in the learning, under which informed trade-offs with the environment, receive and impart of information is possible. This makes inclusive creativity and wisdom flourish, which will be the beginning of the correct movement of educational system in order to achieve the noble training mission in communities (Montazer, 2002).

Despite that teachers and education administrators believe in creative thinking, but they cannot actually access it; because if the necessary conditions for creative thinking are not prepared, creative thinking remains as written. In addition, it should also be noted that educational materials are not the only important thing in university students' education, but the how and the quality of education, the level of their development, interests and experiences affects their education. This belief made specialists pay due attention to selective methods of providing educational materials (Ham and Adams, 2004). Creative thinking means "ability to think about things in new and unusual ways and achieve unique solutions to problems" (Santrock, 2004). There are three major features of creative thinking as follows:

i.   Finding new solutions to a problem (novelty and originality or hypothesizing to solve the problem).

ii.   Providing a theory or hypothesis that is unusual and different from what is accepted by others.

iii. Complexity of thinking process and not expecting it, and also valuable thought (Ranjdoost and Eyvazi, 2013).

Many past research findings support the effectiveness of e-learning for developing students' n creativity. For example, Wheeler, Waiter and Bromfield Wheeler (2002) pointed out that the creativity of students is dramatically increased when using computer-based learning environments. Delavar and Ghorbani (2001) concluded that virtual learning is effective in promoting students' creativity. Bani Hashem, Farokhi Tirandaz, Shahalizadeh and Mashhadi (2014) discovered that e-learning is considered as a positive effective component in the creativity of students. Zanganeh, Mousavi and Badali (2013) found that the use of ICT is effective in the development of creative abilities. The results of the study conducted by Badali, Dana Mazrae, Farokhi Tirandaz and Herfedoost (2013) also showed the effectiveness of e-portfolio in developing creativity and its sub-components (fluency, flexibility, originality and elaboration). In brief, many research findings indicate that e-learning can be implemented in various ways which will benefit students' creativity.

For the purposes of this study, which examines the impact of e-learning on learning and creativity (fluency, originality, flexibility and elaboration) of chemistry students at Payam Noor University of Hamedan; the following hypotheses were formulated:

H1: students in traditional methods of education and students who use electronic methods are significantly different in terms of learning levels.

H2: students in traditional methods of education and students who use electronic methods are significantly different in terms of creativity (fluency, originality, flexibility, and elaboration).

3.   METHODS AND PROCEDURE

The study used a quasi-experimental design with pre-test and post-test with a control group. The statistical population of the study was 100 students from two 50-member classes on pure chemistry at the Payame Noor University of Hamedan who were in the first semester of the 2014-15 session. The sample of the study was selected using Available sampling (20 students from each class) who were randomly placed in an experimental group and a control group. First and before entering the educational intervention, both groups took the pre-test of learning (cognition) and creativity. It should be noted that the criterion of inclusion of participants in the control and experimental groups was their score on the chemistry pre-test and creativity. The step taken was an attempt to ensure that the experimental and control groups of students were similar with regard to their academic ability and creativity.

2.1   Instrument

Instrument used for data collection were an achievement test on the Introduction to Chemistry course developed by the researcher himself, and creative thinking inventory, the Abedi Inventory. The researcher-made achievement test contains 20 objective items in. It has high reliability of .84 and .81 in the pre-test and post test respectively. It has face validity as confirmed by teachers.

The Abedi Inventory was designed by Abedi in 1993. It consists of 60 items where respondents are given 3-options as the response format. The test is made on the basis of Torrance's idea of creativity and measures creativity in the four components of fluency, originality, elaboration and flexibility. Test is easier to implement and score than other tests measuring creativity. The scoring procedure of this test is in a way that test items represent creativity from low to high, and as a result, subjects get a score of 1 to 3, respectively. Raw score of each category represent the lowest to the highest score that every individual can get in those categories. Sum of raw scores of questions 1 to 16 shows the raw score of the category of innovation and ranges from 16 to 48. Sum of raw scores of questions 17 to 38 shows the raw score of fluency and ranges from 22 to 66. Sum of raw scores of questions 39 to 49 shows the raw score of flexibility and ranges from 11 to 33. Sum of raw scores of questions 50 to 60 shows the raw score of elaboration and ranges from 11 to 33. Sum of the scores of these four dimensions shows the whole creativity score. This test was selected since it is valid and is used in various studies. It is such that Emami and Poorseif (2003) reported the reliability of the four components of fluency, originality, flexibility and elaboration as .87, .81, .89 and .86, respectively.

2.2   Procedure

Pre-tests on chemistry and creativity were administered to both classes of students. After scoring the pre-tests, 40 students who had the same scores was selected with equal number from both classes. Twenty students from class A were placed in the experimental group and another 20 students from class B were placed in the control group. For the experimental group,

the content of the course on Introduction to Chemistry was presented through electronic and self-learning methods. The content of the course was presented in the form of training software. The soft-ware was designed by experts to promote self-learning through e-learning elements (applications of multimedia principles, the development and elaboration of topics and questions for further consideration and supportive information). The content of this software was the same as the content presented to the control group, with the exception of the use of the principles of self-directed e-learning. Face validity of this software was confirmed by educational technologists and teachers as experts of the subject. The same content was presented to the control group using traditional method (using textbook and lecture). The training sessions of both groups took place during five one-hour sessions. Then, the two groups were given the chemistry posttest and creativity posttest.

4.   RESULTS, DATA ANALYSIS, AND DISCUSSION

The equivalence of groups was ascertained using a t-test. The results of t-test on the difference in means (M) on chemistry achievement between the e-learning group and traditional group are shown in table 1 and 2.

Table 1. Summary of independent t-test on difference of pre-test means on chemistry achievement

Test	Group	M	SD	df	t	p-value
Pre-test	Control	6	2.30			
	Experimental	7	1.70	38	0.197	0.678

As shown in table 1, there is no statistically significant difference between the means of the two groups (p= 0.678). The results of t-test on the difference in means on creativity between the e-learning group and traditional group are shown in table 3.

Table 2. Summary of independent t-test (based on post-test on chemistry achievement)

Test	Group	M	SD	df	t	p-value
Post-test	Control	7	1.35			
	Experimental	13.50	1.48	38	3.20	0.001

Table 2 shows that the mean scores obtained in post-test by the e-learning group is statistically significantly higher than the traditional group (t=3.20, df = 38, p=0.001). This means that the use of electronic education affects the learning in the experimental group.

The results of t-test on the difference in means (M) on creativity between the e-learning group and traditional group are shown in table 3 and 4.

Table 3. Summary of independent t-test on the difference of creativity pre-test means between groups

Test	Dimensions		Fluency		Originality		Flexibility		Elaboration	
	Groups	Number	M	SD	M	SD	M	SD	M	SD
Pre-test	Control	20	5	0.39	6	1.22	8	1.50	5.30	1.67
	Experimental	20	6	0.78	7	1.46	9	0.89	6.45	1.21

As demonstrated in table 3, mean and standard deviation of the control and experimental groups' scores on fluency, originality, flexibility, and elaboration in the pre-test phase are not similar to each other indicating that the two groups are similar in their level of creativity.

Descriptive statistics on creativity shown in table 4 indicates that there is a difference in creativity level between groups.

Table 4. Summary of mean & SD (Post-test creativity)

Test	Dimensions		Fluency		Originality		Flexibility		Elaboration	
	Groups	Number	M	SD	M	SD	M	SD	M	SD
Post-test	Control	20	6.69	0.67	9.63	1.23	10.30	1.12	6.95	1.25
	Experimental	20	13	0.81	13.50	1.15	14.25	1.17	13	1.15

The post-test scores of the experimental group are much higher than the control group. T-test conducted on the differences is shown in table 5.

Table 5. Summary of independent t-test (based on creativity post-test)

Dimensions	Test	Group	M	SD	t	p-value
Fluency	Pre-test	Control	5	.39		
		Experimental	6	.78	0.178	0.657
	Post-test	Control	6.69	.67		
		Experimental	13	.81	4.67	0.001*
Originality	Pre-test	Control	6	1.22		
		Experimental	7	1.46	0.345	0.568
	Post-test	Control	9.63	1.23		
		Experimental	13.50	1.15	8.87	0.001*
Flexibility	Pre-test	Control	8	1.50		
		Experimental	9	.89	0.679	0.354
	Post-test	Control	10.30	1.12		
		Experimental	14.25	1.17	4.73	0.001*
Elaboration	Pre-test	Control	5.30	1.67		
		Experimental	6.45	1.21	0.654	0.430
	Post-test	Control	6.95	1.25		
		Experimental	13	1.15	4.23	0.001*

$p<.05$, difference is statistically significant

As indicated in table 5, in pretest phase there is no significant difference between scores of fluency, flexibility, originality, and elaboration. However, considering the mean scores in post-test phase, the scores of fluency, originality, flexibility, and elaboration are significantly different between control and experimental groups, where the experimental groups score higher on all measures.

5. DISCUSSION AND CONCLUSION

The study set out to investigate if using self-directed e-learning can be effective for student's learning on basic chemistry and creativity. Matched design was used and comparison between groups indicates that the self-directed e-learning group achieves better marks in chemistry and their creativity is higher than the traditional group. Therefore, it can be said that the use self-directed of e-learning method is more effective for improving students' creativity (fluency, originality, flexibility, and elaboration) and creativity compared to the traditional lecture method. The findings are expected as the self-directed e-learning method promotes independent efforts from students, to search for answers themselves instead of relying on their teachers. The self-search leads to self-reliance and greater information gathered from widely available scientific sources. Multiple answers to a particular question are obtained that force them to make wise decisions on appropriate answers which nurture their creativity in the process.

The use of pictures and sound that is the typical characteristic of e-learning, help to make learning more internalized, which can positively affect students' creativity. According to the study of Keshavarz et al. (2013), Zarei, Zavaraki and Rezai (2011), Gorbi (2013), and Zare et al. (2015), indicate that taking advantage of a variety of ICT in the teaching and learning process can be effective in increasing students' creativity. On the other hand, e-learning will also enable students to specify their learning trend with respect to their own problems and abilities. This independence in studying and learning is the effective element in learning that is not used in regular traditional classes; the ICT application in e-learning enables learners to control their learning process. Adjustability of training trend by learners is one of the important reasons concerning the effectiveness of e-learning in increasing the learning rate of learners. With a review of research by Wheeler, Waiter, and Bromfield (2002), Delavar and Ghorbani (2011), Banihashem et al. (2014), Zanganeh et al. (2014), and Badali et al. (2014) and also with reference to the above finding, it can be seen that explaining the effectiveness of self-directed e-learning on students' learning can be expected. In conclusion, self-directed e-learning method used in chemistry training is effective at developing subject content knowledge as well as creativity.

6.   RECOMMENDATIONS

The availability of advanced ICT provides educators and educational managers the opportunity to undertake educational reforms and innovations that could result in increased efficiency and effectiveness of an education system. ICT also has been shown to support the three forms of learning i.e., problem solving, critical learning and creative learning that are different methods of student-oriented, creative and critical-based learning. Thus, educators and managers should seriously consider ways of integrating the use of ICT in education and training. Training and programme development specialists can prepare specialized training courses that provide learners with theoretical and practical tools enabling them to promote and strengthen their scientific and technical knowledge and skills.

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