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Project-based learning as a facilitator to promote students' technology competencies

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Abstract

Due to the close relationship between educational technology as a field of study on the one hand and technological progress as a fact on the other, the very nature of this field has undergone tremendous shift which has resulted in a transmogrification, changes which are evinced by the roles of educational technologist. Therefore, not only should educational technology training centers aim at transferring concepts related to this major to learners, but they should also focus on developing basic skills that students need, such as technological competencies.This article sought to examine the effects of project-based learning strategy (PoBL) on students' technology competency in a system-based education course offered in the educational technology department of Arak University in Iran. In order to achieve this end, a sample of 78 students majoring in the field of educational technology who enrolled in the system-based education course was selected. Subjects were randomly assigned to one of two groups: the experimental group (PoBL strategy) and the control group (conventional teaching strategy). The educational course involved 12 sessions over the course of one semester of the 2011-2012 academic year, with each session lasting approximately 90 minutes. The technology competency questionnaire was administrated three times (i.e. pretest, post-test one, and post-test two), while the experimental group received the PoBL strategy and the control group was exposed to conventional teaching (CT) methods. The results of two way repeated measure ANOVA revealed that students who were taught using Poll strategy performed better in terms of technology competency compared to students who were taught using CT strategy.

Keywords: project-based learning, technology competency, educational technology.

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1. Introduction

In the modern world of rapid information dissemination and technological advancement, universities have additional responsibilities other than teaching declarative or propositional knowledge and pedagogical skills to their students; they must also take pains to ensure that students leave with other general skills (e.g. critical thinking, self-direction skills, problem solving, communication skills, technological competencies) which coincide with society's turbulent demands (Salpeter, 2003; Hmelo-Silver, 2004).

The development of basic skills is the foremost priority of experts in educational technology (ET). Due to the close relationship between educational technology as a field of study on the one hand and technological progress as a fact on the other, the very nature of this field has undergone tremendous shift, which has resulted in a transmogrification, changes which are evinced by the roles of specialists (Surry & Robinson, 2001; Izmirli & Kurt, 2009).

Educational technologists' roles are also more complicated than they were in the past when they were confined to school and instructional material preparation for students/teachers. As of late, experts in instructional technologies have woven technology into the fabric of education. (Davidson, 2003). Therefore, parallel to the changes in instructional technologies, the competencies of an instructional technologist are observed to be changing. Tennyson (2001) defines an instructional technologist as a person who executes the process of instructional designing to deal with the needs in technology-based learning environments and to solve the learning and performance problems, while according to Sugar (2005), an instructional technologist is a person who solves the problems related to technical equipment in schools and helps teachers and directors use technology effectively. Sugar further defines an instructional technologist as a technology coach who helps and guides teachers to overcome the problems they may experience while using technology.

In this day and age, graduates of educational technology are expected to have experience in the field as well as deftness in handling computer and multimedia equipment. In educational technology, while there has been a gradual decline in employers' demands for basic knowledge and skills, the demand for computer knowledge and skills (software, hardware) has increased. Therefore, not only should educational technology training centers aim at transferring concepts related to this major to learners, but they should also focus on developing basic skills that students need, such as technological competencies. A new approach to educational technology training should provide both the domain knowledge and opportunities to learn and develop these skills. With this goal comes the question: how can we teach the core body of knowledge, while at the same time developing students' essential skills? As Sendang and Ferhan OdabasI (2009) suggested, one possible solution involves our teaching methods. We should employ methods that give students opportunities to develop their self-directed learning, develop their technological skills, become more accomplished problem solvers, and learn the subject matter. Project-based learning (PoBL) teaching methods may offer specific solutions to this conundrum.

PoBL is a model that organizes learning around projects. Learners choose how to approach a problem and what activities to follow. They gather information from a variety of sources and combine, analyze and derive knowledge from it. Their learning is inherently valuable because it is connected to something real and involves adult skills such as cooperation and reflection. In the end, students display their newly acquired knowledge and are judged by the instructors in terms of what they have learned and how well they communicate it. According to this method, the teacher's role is to guide and advise the students on how to become more effective learners and apply the learning materials rather than to get involved and to manage students' work (Thomas, 2000; Scarbrough et al., 2004).

Projects are complex in nature and are designed based on challenging questions or problems that students face. Students are involved in solving problems and making decisions through various activities in order to facilitate more permanent cognitive retention of the subject matter. They also provide students with opportunities to work autonomously over extended periods of time; such activities often culminate in realistic products or presentations (Karaman & Celik, 2008; Cavanaugh, 2004).

The PoBL approach focuses on "doing something" instead of "learning about something" (Moursund, 2003). In terms of its basic features, PoBL is an influential approach capable of ensuring meaningful learning in higher education (Gultekin, 2005). Thus, the teaching-learning process at the level of higher education should be reorganized through constructive, creative, and generative activities rather than dull and memorization oriented activities. In this regard, PoBL could foreseeably ensure more effective result by allowing students to actively participate in the learning process and allowing them to produce something in collaboration with others. Students are encouraged to solve challenging problems that are authentic, curriculum-based, and often interdisciplinary (Turgut, 2008; Seo, 2008).

A learning approach based on the project not only establishes a profound and high level of knowledge among students, but also creates opportunities in which students can learn in a self-directed manner and in accordance with learning objectives. Additionally, within such a framework, they will be able to take advantage of technologies efficiently (Williams, 2003; Turgut, 2008).

1.1. Purpose of the study

The main purpose of the study is to investigate the effect of PoBL strategy on students' technology competencies. It was supposed that the students who were taught using PoBL strategy would perform better in terms of technology competencies than would students who were taught using CT strategy.

2. Research method

In this study, true-experimental design (pretest-posttest with control group) was used. The sample consisted of 78 third year educational technology undergraduates enrolled in the system-based education course in Arak University in Iran. Students were randomly assigned in experimental group and control group. Students in experimental group were taught with PoBL strategy, and students in control group were taught with conventional teaching strategy. After assigning the students into control and experimental groups, the pre-test phase questionnaires were administered to both groups.

Technology Competency Questionnaire is measured by knowledge, skills, and attitudes towards ICT scales taken from the technology competency questionnaire (Preparedness Measurement Questionnaire). This questionnaire was developed by Wong in 2002. It is a valid and reliable instrument (Wong, 2002). This scale consists of three parts: knowledge, skills, and attitudes toward ICT. The skills have 74 items that measure the actual skills of participants. It is designed to determine if the participants are able to perform each given task. Each item was written according to a specific skill that was recommended by North Carolina State Board of Education Educator Technology Competences (Wong, 2002). Knowledge about ICT scale has 25 items and it measures the participant's actual IT knowledge. Attitude toward ICT scale has 34 items and is used to measure attitudes toward ICT. Technology Competency Questionnaire was administered three times. The first time was regarded as pre-test, the second – as post-test in which six weeks of PoBL strategy had taken place, and lastly, there was another post-test in which 12 weeks of PBL took place. Repeated measure (ANOVA) was employed to test the effects of PBL strategy on students' performance related to technology competencies. This study took four months, which included twelve sessions, and both groups had one session in each week, which took one and half an hour.

System-based education course in educational department of Arak University in Iran was selected for applying the PoBL strategy. In experimental group, the teaching approach was based on project-based learning principles (Sidman-Taveau, 2006). These principles are: 1) the organization of learning around real world problems, 2) student-centered instruction, 3) collaboration, 4) teacher as facilitator, 5) authenticity through the use of authentic materials and audiences, 6) formative assessment, 7) reflection, 8) the production of authentic artifacts. In PoBL group, students designed and applied the projects based on the concepts of the system-based education course. As it was mentioned before, this study was done during twelve sessions. Based on the content of the lesson, two projects were done by students. The pivotal elements of these projects were essentially based on the following: a) Systematic investigation of one of the educational problems. B).The application of all instructional design model procedures to remove the problem, such as selection of the audience, need analysis, determination of objectives, media, content, and assessment methods. These two pivots related to the project-based learning covered all concepts of the course.

In the other group, CT strategy was applied. CT strategy refers to teacher-centered teaching strategies through which the teacher introduces the topic or concept of learning, demonstrates practical examples on the board, and later asks students to apply the principles and rules learnt by answering similar questions as shown in the worked example. The instruction given here is non-inte

3. Findings

Descriptive data analysis was conducted to determine means and standard deviations of technology competency scores in each condition of experiment. Given that all data were interval in nature, means were used as measure of central tendency and standard deviations as the indices of variability for the data. The results of descriptive data analysis of technology competency scores are presented in Table

Table 1. Mean and standard deviation of technology competency in experimental and control groups

	Groups	Measurement	Mean	SD
Technology competency	CT strategy	Pre-test	172.52	36.47
	PoBL strategy		170.92	24.29
	CT strategy	Post-test one	174.42	36.69
	PoBL strategy		200.3	28.08
	CT strategy	Post-test two	175.28	36.69
	PoBL strategy		209.4	26.88

Table1 shows that CT strategy group in the pre-test stage obtained 172.52 as a mean of technology competency with a standard deviation of 34.47. The overall mean of technology competency of the PoBL strategy group on the pretest was 170.92, with a standard deviation of 24.29. In the post-test, the PoBL strategy group demonstrated better performance for technology competency (M=200.3, SD=28.08) than did the CT strategy group (M=174.42, SD=38.69). Finally, in post-test two (time three), the overall mean of technology competency in the PoBL strategy group increased to a higher level of 209.4, with a standard deviation of 26.88. However, the mean of technology competency in the CT strategy group in post-test two was 172.28, with a standard deviation of 36.69.

Two-way repeated measure ANOVA was conducted to determine the differences of technology competency between the experimental and control groups. The results of this analysis are provided in Table 2.

Table 2. Repeated Measure ANOVA of technology competence

	SS	df	MS	F	P	η
Between-subject effects						
Group (G)	21959.826	1	21959.826	9.62	.007	.091
Error	218867.272	76	2879.833			
Within-subject effects						
Measurement (M)	17979.15	2	8989.577	65.19	.000	.462
M * G	13583.87	2	6791.936	49.25	.000	.393
Error	20959.45	152	137.891			

With respect to Table 2, the data show that the experimental and the control groups are statistically different in overall technology competency, $F(1.76)=9.62$, $p<.007$, $\eta=.09$. The data also illustrates the significant differences between the three sequencing measurements, $F(2.152)=65.19$, $p<.000$, $\eta=.462$. Furthermore, it was indicated that the interaction effect between group and measurements is statistically significant with a large effect size. $F(2,152)=49.25$, $p<.000$, $\eta=.393$. Based on the results in Table 2, there was strong evidence to suggest that the technology competency of PoBL strategy group is significantly higher than that of the CT strategy group. To aid in the interpretation of differences, it would be useful to examine the graph presented Figure 1.

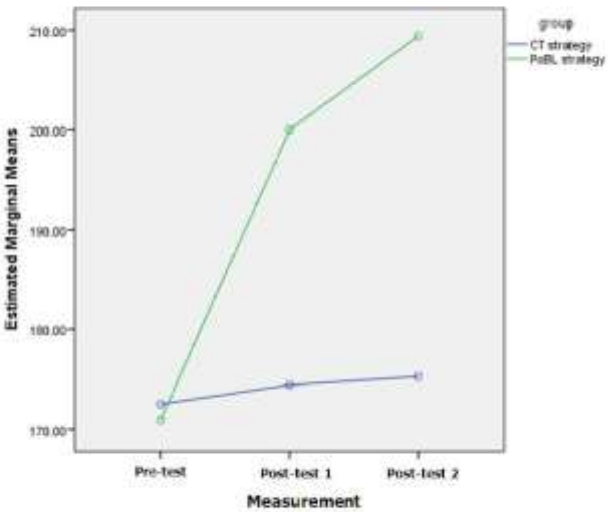

Figure 1. Estimate marginal means of technology competency

This Figure shows that overall technology competency across the three measurements is dependent on the type of teaching strategies they received. In summary, the results indicate that PoBL strategy helped the students from the experimental group to improve their technology competency. Although there is a general increase in the overall technology competency across the three measurements for two groups, the rate of increase is greater for the PoBL group from pre-test to post-test two than for the CT strategy group. Furthermore, the results presented in Table 2 showed that there was an overall significant difference in means, but we do not know where those differences occurred. For this purpose, the Pairwise Comparison Test was used (Table 3).

Table 3. Perwise Comparison Test

	Measurement	Mean Difference	Std. Error	Sig.
Pre-test	Post-tes one	-15.503	2.196	.000
	Post-test tow	-20.625	2.093	.000
Post-test one	Pre-test	15.503	2.196	.000
	Post-test two	-5.122	1.187	.000
Post-test two	Pre-test	20.625	2.093	.000
	Post-test one	5.122	1.187	.000

Based on Table 3, it can be concluded that in terms of technology competency, there is a significant difference between pretest and post-test one, $p<.000$. The results also show that the differences between pretest and post-test two is statistically significant, $p>.000$, Furthermore, the data approved that the difference between post-test one and post-test two was also statistically significant, $p>.000$.

4. Discussion

In the present study, the technological competencies (knowledge, skills, and attitude toward technology) of the learners in PoBL contexts and traditional learning are taken into consideration. The technological skills of the learners were measured at the beginning, middle, and the end of the course. Results obtained demonstrated that there exists a significant difference in terms of learners' technological competencies between the PoBL and CT strategy groups. This indicates that the scores the learners obtained on the technology competency variable in the experimental group were higher than those in the control group, and that the difference was significant. In the study, the students in the PoBL group gained the opportunity to increase their knowledge of the course as well as enhance their knowledge of the vital 21st century realm of technology competencies.

The nature of PoBL allows learners to make the best possible use of technology in all its stages. The main stages of PoBL are problem finding, research and investigation, production, and presenting a report. Students can make use of technology in all these steps. Although PoBL is primarily aimed at developing students' learning of course concepts, their basic skills, such as technology competency, improve as well. Unlike other studies that used PoBL for teaching computers and technology, the present study employed PoBL on courses other than technology courses. In light of this, students could effectively use their technological abilities in doing the projects. Success in PoBL necessitates the use of different software for searching out information, communicating with others and giving presentations. In PoBL, students' knowledge of technology is not restricted to the knowledge level. Instead, students use such knowledge actively. Involvement in engaging projects prompts students to make use of their technological abilities to enhance the quality of the project, which will in turn develop their technological skills. Students need to be in regular contact with each other to be able to fulfill their projects. Email and software designed for chatting give them the opportunity to communicate with each other without necessarily seeing each other. They search for their answers on the Internet, run on-line discussions with their friends and may even raise their questions on related websites.

Students' main use of technology, especially computer and related software, is in the process of doing projects. The students worked collaboratively to implement their projects in a particular media format. They benefitted from computers to provide their own productions and utilized various media, such as Photoshop, PowerPoint, FrontPage, etc. The students were provided with all of the essential facilities, including computer and instructional software.

The findings of this study bear a verisimilitude to that of previous research. An investigation was done by Seo et al. (2008) on pre-service teachers' multimedia abilities. In this study, teachers' multimedia ability was measured prior to the commencement of the course. Teachers were then subjected to project-based learning, during which they had the chance to devise multimedia projects using software such as word. At the end of the course, teachers' attitude and skill in technology and multimedia were reassessed. Findings revealed that teachers' attitude and skill in terms of ICT and multimedia had developed. Prior to development of the projects, they were most familiar with Word and PowerPoint. On a scale of 1 to 5, with 5 indicating excellent, the pre-service teachers rated their level of proficiency with Word an average of 4.29 and PowerPoint 4.13. Upon completing the projects, their ratings increased from 4.29 to 4.85 for Word and from 4.13 to 4.47 for PowerPoint. More importantly, in terms of the programs they had been less confident about (Mozilla, Inspiration, and MovieMaker), their level of proficiency greatly improved after the projects from 1.24 to 3.91 for Mozilla, from 1.35 to 3.95 for inspiration, and from 1.53 to 3.91 for moviemaker.

A study of pre-service teachers enrolled in an undergraduate educational technology course at the University of Oklahoma found that students developing projects in the field of telecommunications developed sophistication in using the web, and learned about a new technology through the project-development process (Land, S. & Greene, B. 2000).

Bell (2010) has taken the stance that PoBL is able to ameliorate students' skills and fulfill their educational needs. Bell showed that PoBL combined with technology could contribute to learning course materials. The researcher contends that technology can promote PoBL. On the one hand, the flexible nature of PoBL gives learners the opportunity to employ technology effectively. On the other hand, the potentials that technology provides lead to the fulfillment of the objectives of PoBL.

The findings from this study have provided valid evidence that to a certain extent, the PoBL strategy is superior to the conventional teaching strategy. The application of the PoBL strategy in classrooms can be beneficial to students, as this instructional strategy has been proven to improve student's performance and basic skills.

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