

Effects of Project-based Learning Strategy on Self-directed Learning Skills of Educational Technology Students

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Abstract

Given the importance of globalization as well as the need to train skilled and knowledgeable employees for the 21st century workforce, higher education needs to take a more critical look at the educational practices and instructional methods which lead to improvements in students' essential skills such as self-directed learning. This study sought to examine the effects of project-based learning (PoBL) strategy on students' self-directed learning skills 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 in the field of educational technology who enrolled in the system-based education course was selected. Subjects were randomly assigned to one of the two groups: the experimental group (PoBL strategy) and control group (conventional teaching strategy). The self-directed learning readiness scale (SDLRS) was administered three times (i.e. pretest, post-test one, and post-test two). 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 tests revealed that students who were taught using PoBL strategy performed significantly better in terms of self-directed learning skills than did students who were taught using CT strategy.

Keywords: *Project-based learning; Self-directed learning; Educational technology; Higher education*

Introduction

Current educational theories take into consideration the fostering of essential skills, such as self-directed learning in an educational environment which coincide with 21st century society's turbulent demands (ChanLin, 2008). Self-directed learning is one of the best ways to learn. There is convincing evidence that people who take the initiative to learn tend to learn more and better than those who fail to do so (Knowles, 1975). This is also supported by Brockett and Hiemstra (1991), who found that students who exhibited more self-directed learning behaviors tend to perform better academically than students who did not.

To be a self-directed learner is to have the ability to identify and achieve learning goals through the effective use of learning strategies and to understand, monitor, manage, evaluate, and reflect on one's own learning (Tillema, 2000). Self-directed learning focuses on the process by which

learners take control of their own learning, set their own learning goals to locate appropriate resources, decide on learning methods to use, and evaluate their own progress (Findley, 2009). It is essential for students to be self-directed learners in order to experience effective university as well as lifelong learning (Lunyk-Child et al, 2003).

The development of basic skills such as self-directed learning is the foremost priority of experts in educational technology. 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 transmutation, changes which are evinced by the roles of specialists (Surry & Robinson, 2001).

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). Thus, parallel to the changes in instructional technologies, the competencies of an instructional technologist are observed to be changing. Surry and Robinson (2001) assert that the roles and duties of an educational technology graduate include the following: instructional designer, distance learning coordinator, instructional technology manager/administrator, and technical support specialist. In order for fresh graduates to undertake such duties with an acceptable level of competency, they must be equipped with the fundamental requisite skills. Surry and Robinson examined job applications in the area of instructional design and technology, and based on the criteria required for these job applications, determined the skills and field-knowledge that graduates of instructional technology should possess, they state that instructional technologists are expected to have high-level skills in individual communication and management, self-direction, team work, and in the use of new technologies. 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 self-directed learning, group learning activities, technology competencies, critical thinking, problem solving, etc. A new approach should provide both the domain knowledge as well as 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 Sendag and Odabasli (2009) suggested, one possible solution involves our teaching methods.

The vast preponderance of teaching in the field of educational technology in Iran is based on traditional methodologies (Fahimzadeh, 2002). Although lecturers in educational technology are familiar with new teaching methods, they still prefer the traditional lecture type of teaching or, as it might be called, a teacher-centered strategy (Khosravi, 2006). Lecturers generally take responsibility for classroom learning activities; it is common for them to adhere to a pre-prepared curricula provided by the university, provide materials without considering the needs of students, conduct learning activities and design learning plans based on their own choices which might be contaminated by their own educational backgrounds, beliefs and experiences, and evaluate learning outcomes through exams (Nasr Esfahani, 2003). This process reflects a traditional process-product model in which inputs and outputs are controlled in advance without consideration of students' needs. This means that students are accustomed to passively listening and following the teachers' instructions. Students have little freedom over what they learn and the

way they are evaluated. As a result, most students lack exposure to independent study or student-directed learning activities which would allow them to identify their own learning needs and guide their learning process. Research concerning the metacognitive skills of educational technology students illustrates the shortcomings of traditional teaching methods in terms of equipping students with the requisite skills they need to stay afloat in the modern world of rapid technological growth (Fahimzadeh, 2002). In another study based on internal evaluation carried out at the Educational Technology Department of Arak university on students knowledge, attitude and skills, it was revealed that teaching methods are not a determining factor in students' decision to utilize technologies and improve of their essential skills (Seifi et al., 2006). This study indicates that teaching methods are mostly concentrated on low level learning objectives which oblige students to memorize concepts without understanding their practical applicability to real life situations. These students memorize such concepts for the sole purpose of passing courses.

It seems that the current state of teaching largely excludes autonomous and self-directed learning approaches. Traditional teacher-centered instruction via lecture does little to foster essential skill development, seeing as how students are rarely given assignments outside the classroom which could readily translate into real-life practicability (Mousavi, 2006). All these reports and evidence indicate the existence of a gap between what the students learn in universities and what they do in practice after graduation. This fails to paint a complete picture of the process of teaching essential skills in universities since they are of no practicality in real world situations. This study attempts to address this gap by introducing PoBL as a remedial factor to bridge the gap between theory and practice. In other words, in order to increase the practicality of the materials students learn in universities, this study recommends PoBL as a possible means of bridging the gap. PoBL as a teaching technique could be a natural extension to many existing educational technology courses. This claim is supported by certain innovative ideas in the field which state that PoBL provides opportunities for growing students' basic skills such as self-directed learning skills among students (Thomas, 2000). Harding et al. (2007) conducted a study on students' self-directed learning in PoBL contexts. In their study, the experimental group consisted of 33 students while the control group consisted of 34 students from the engineering faculty. The study was carried out over a ten-week period. Findings showed that the learners who were instructed in PoBL situations obtained higher scores than their counterparts in the control group. Moreover, in another study, Savage et al. (2009) stressed the importance of essential skills, such as self-directed skills, as important skill of the 21st century and studied the effect of PoBL on the enhancement of self-directed skills. The study found a significant difference between PoBL and teacher-centered learning.

Specifically, a study done by Zhou & Lee (2009), which investigated possible differences between the self-directed learning skills of students exposed to the problem based project learning strategy and those of the traditional instruction, indicated that the treatment group performed better on the self-directed learning readiness scale. It was also noted that the students' in the PoBL strategy perceived that they were more actively involved in exploration and that the process of PoBL helped them to understand the course concepts better. A study conducted by Rahman et al. (2009) also indicated that the experimental group which was taught according to the PoBL strategy performed better in self-regulation in learning.

In the present study, it is basically hypothesized that due to its own special capabilities, the PoBL strategy can create opportunities for students to adjust themselves in accord with their pedagogical needs and appropriately prepare themselves for the ever changing world around.

The PoBL, a new approach in the process of teaching-learning, is based on the underlying concepts, principles, and paradigms. This approach tries to motivate the students to do research leading to problem-solving and meaningful activities, allows them to experience independently, add to their previous knowledge and learn in a natural and real-life situation (Blumenfeld et al., 1991). This approach allows the teacher and students to ponder deeply about delicate and worthy subjects and issues. In this approach, the content of materials is meaningful to the students since they have been taken from their daily life and the real world around them (Kramer et al., 2007). 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). In the PoBL, the learners investigate to find out the answers to the questions which are not typically easy to answer. Finding the answers requires the learners to think deeply, investigate, collect the necessary data, predict, analyze the data, combine and interpret the results, evaluate the findings and finally present solutions to the problem (Thomas et al., 1999).

The key feature of PoBL is that it does not focus on learning of things but it focuses on performing things. In fact, students learn by discovering, innovating, and performing (Blumenfeld et al., 1991). 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 (Seo et al., 2008; Turgut, 2008).

The PoBL not only reinforces the cooperation among learners in performing group works but also reiterates individual and independent learning. This approach provides the students with the individualistic, social and cooperative skills. In addition, the PoBL emphasizes the application of technological tools, manual forces, and physical movements (Thomas, 2000). This approach, on the other hand, allows the students to apply the previously learned materials in their real-life situations and occupational areas. Interestingly, the students who participate actively in the project-based process self-evaluate and self-direct themselves. In other words, they concern themselves with meta-cognitive skills which pave the way for long-lasting learning (Bell, 2010; Mills & Treagust, 2003). PoBL is an instructional method which creates conditions under which students' self-directed learning will be promoted, for the reason that this method enables students to recognize their learning needs, identify objectives, search recourses, and answers their questions and share their knowledge with others in an autonomous way.

The main purpose of this study is to investigate the effect of PoBL strategy on students' self-directed learning skills. It is supposed that the students who are taught using PoBL strategy performed better in terms of self-directed learning skills than do students who were taught using CT strategy.

Methodology

To study the causal effects of the PoBL strategy in a classroom setting, a true-experimental design (randomized pre-test, post-test with control group) was conducted. According to Ary et. al (2009), "in a true-experimental design, subjects are randomly assigned to groups and, because of the control they provide, are the most highly recommended design for experimentation in education" (p. 134). Additionally, Campbell and Stanley (1963) state that through this type of research design threats to internal validity can be reduced; thereby allowing the researcher to interpret the gains in the post-tests as the effect of the treatments. In this research, every possible attempt has been made to choose a design that eliminates internal threats. The design of the present study is true-experimental, whereby students were randomly assigned to experimental and control groups.

The sample consisted of 78 third-year educational technology undergraduates enrolled in the system-based education course in Arak University in Iran. Arak University is located in Arak, a city in the center of the Islamic Republic of Iran. This university is one of the major universities in Iran which admits students to educational technology through a high stake nationwide test called University Entrance Exam (UEE); Arak University also runs an MA program in this field. It must also be mentioned that this university admits students every semester during any academic year. The system-based education course was randomly selected out of 9 special courses that were offered by the educational technology department of Arak University in the First semester 2011-2012. The course is offered each semester as a compulsory course and it is the main course in educational technology which all students are required to take. Students were then randomly assigned into two groups. There were 38 students in the experimental group and 40 students in conventional teaching group. The experimental group was taught using the PoBL strategy (the treatment), whereas the conventional teaching strategy was used for the control group. 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.

In the experimental group, the teaching approach was based on PoBL principles. These principles are as follows: (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 (Barron et al., 1998; Blumenfeld et al., 1991; Sidman-Taveau,2005). 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 12 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 followings: 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.

Students in each group had six weeks to complete each project. These two pivots related to the PoBL covered all concepts of the course and teacher and students applied procedures of the PoBL (Moursound, 2003) in terms of the following fashion:

- *Organizing the groups:* The students were assigned to one of five groups (each group consisted of 7-8 students). Each group was given an individual profile along with the students' specifications in a file. It is to note that the students were assigned to groups based on factors such as gender and proficiency levels, so that each group involved both male and female students of various abilities (low, mid, and high). In this phase, the instructor provided the students with an explanation of group workings and the rules for working in a group, including respecting the other students' views, allowing them to express themselves, and dividing the tasks among each other proportionately. For example, each group consisted of a president and a spokesman. These roles were also transferred to other group members.
- *Stating the subject and sub-subjects:* In the first step, the teacher offered an explanation and introduced PoBL and got students fully acquainted with the concepts and procedural processes of PoBL strategy. Teachers (instructors) assisted students peripherally and indirectly introduced the concepts. Students categorized the concepts, determined subjects and sub-subjects, and identified necessary resources under supervision of the teacher.
- *Designing project:* Students determined the objectives of the course based on the concepts of the lesson. They initially designed the plan of the project while receiving assistance from their teacher. Students explored the resources in order to create a frame for the project they stated questions about. They also created interesting questions and categorized the problems. Most of the points and materials of the project were key questions which were essential to understanding the concepts. Some of these key points were: where should it be started?, what is the main problem?, what implementations must be done to remove the problems?, and so forth. In fact, students determined their objectives in their project plans. Students proposed a situation in which they liked to carry out their projects in accordance with the course content. The students, in each group, analyzed their suggested situations systematically. For instance, they discussed such elements as input, output, process, sub-system, meta-system etc. The suggested situations by the students were as follows: A high school in Arak city, district one, the instructional center of Arak Mashin Sazi Company, the instructional technology department of Arak University, Arak school for the mentally challenged "Ebrahim Fakhar" and the agriculture department of Arak University. All groups, based on needs analyses of the selected situation, identified the educational needs of situations and offered a plan for eliminating problems. The project plan consisted of: (1) introducing the situation; (2) selection of a need analysis model for finding the problem; (3) introducing the problem;

and (4) offering the design for detaching the problem based on instructional design procedure.

- Application of the project:* In this phase, students in the groups entered the project production stage (e.g. in project number 1, students went to the suggested places according to their respective projects to gather data through questionnaires, interviews, etc.). The students presented their subject-matter using a specific media. For example, the students who were in Arak's instructional technology situation analyzed the low proficiency of students in applying the practical software. The group members tried to provide instructional software such as PowerPoint instruction. The groups who worked in the high school situation attempted to run an instructional weblog on the cognitive initiatives. 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, Front page, etc. The students were provided with all necessary facilities, including computer and instructional software. Within the project application, the students were not only intensely engaged in doing their projects, but they also had to spend much more time out of class to finish their own projects. In PoBL, the students not only learn the media and the principles for their application but also utilize all their obtained concepts in their own productions. The students benefitted from the various methods and strategies in their productions. The students' main production was the instructional software. They utilized various Multimedia, graphic, film etc. in their production. In fact, they applied their technological knowledge and skills in an effective way. It was occasionally necessary for the students themselves to supply films, photos, reports and interviews, which they blended into their own projects.
- Presentation:* In this step, students presented their project results in terms of prepared software, tables, posters, charts and diagrams, movies, photos and images, etc. Students then discussed possible applications of the project which might benefit their own classes, other schools, seminars and any other organization. In this phase, as in the previous phases, the role of the teacher was to guide students along and determine criteria for the application of the project, such as how and when to present them.
- Evaluation:* The evaluation procedures used in the PoBL strategy are totally different from that of its counterpart, the traditional method (i.e. conventional teaching). Generally speaking, assessment and evaluation in PoBL is almost qualitative. In the evaluation phase of this study, the teacher was not the only one who evaluated the projects. Group members also took part in evaluating each other, and members of each group also compared their own projects with those of other members within and out of their group. The role of teacher, in this phase, was to determine the criteria for evaluation and to produce or withdraw from other students' opinions. These criteria included applicable, creative, and interesting resolutions.

In the control group, conventional teaching strategy consisted of induction phase, acquisition phase, and assessment phase. The lecturer started the induction phase by asking learners to recall

the lesson they had previously learned. In this stage, it is probable that students do the assignments the teacher gave them in class. The conventional teaching strategy was implemented through a lecture in the acquisition phase, which consisted of whole-class instruction, without small groups and incorporating the following activities: the system-based education concepts explained by one of or some of the following equipments: whiteboard, overhead, and projector. Students asked questions to process individually, and then highlighted the important concepts, after which the lecturer handled the discussion of the conclusion of the lesson. At the end of the class, teacher asked the students some questions to ensure they had understood the concepts. Moreover, in this method, students were actively involved. Students' involvement in the traditional class took on of the following forms:

- Voluntary presentation of some parts of the lesson,
- Doing assignments that the teacher suggests according to the topic of lesson.

Self-Directed Learning Readiness Scale (SDLRS) was used to collecting data (Fisher et al., 2001). The SDLRS includes three subscales: self-management; related to learning process activities, desire for learning; associated with taking responsibility for learning, and self-control; related to control of the learning process. There are 41 items on this scale, which consists of three subscales, self-management (13 items), desire for learning (14 items), and self-control (14 items). The researcher used this instrument for gathering information about learners' self directed learning before, during, and after applying the desired teaching strategies. Fisher et al. (2001) reported a high internal consistency reliability of 0.92 for their self-directed learning scale. In this study the overall reliability generated for SDLRS was 0.87 Cronbach alpha, and the values calculated for self-management subscale, desire for learning subscale, and self-control subscale was 0.90, 0.86, and 0.87 respectively. In this study, self-directed learning skills of the students were measured three times (pre-test, post-test one, and post-test two) and to analyze the data mixed design repeated measure ANOVA was used.

Additionally, exploratory data analysis (EDA) was conducted for all the data collected in the pre-test, post-test one, and post-test two. This was done to ensure that the data met the assumptions of the statistical test. In this research, the Skewness index was computed to understand the normal distribution of variables. Based on Leech et al. (2007), if the skewness is less than ± 1 , the variable is at least approximately normal. The value of Skewness for data in pre-test, post-test one and post-test two was reported 0.87, 0.85, and 0.69 respectively.

Findings

Descriptive data analysis was conducted to determine means and standard deviations of self-directed learning 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 self-directed learning scores are presented in Table 1.

Table 1. Means and Standard Deviations of Self-directed Learning in PoBL Strategy and CT Strategy Group

	Groups	Measurement	Mean	SD
Self-directed learning	CT strategy	Pretest	151.6	15.1
	PoBL strategy		149.6	15.4
	CT strategy	Posttest one	153.3	12.8
	PoBL strategy		165.5	10.3
	CT strategy	Posttest two	153.4	13.6
	PoBL strategy		169.2	10.9

As it can be seen in Table 1, the self-directed learning mean score of the CT strategy group in the pre-test was 151.16, and it's standard deviation was 15.1. The self-directed learning mean scores for PoBL strategy group in pre-test stage was 149.6, with a standard deviation of 15.4. In post-test one, the PoBL strategy group achieved a higher mean score in self-directed learning (M=165.5, SD=10.3) than did the CT strategy group (M=153.3, SD=12.8). Finally, in post-test two, self-directed learning skills were measured for the third time. The self-directed learning mean score in the PoBL strategy group increased to a higher level of 169.2, with a standard deviation of 10.9. However, the mean of self-directed learning in the CT strategy group in post-test two was 153.4, with a standard deviation of 13.6.

The repeated measure ANOVA was performed to find the significant treatment effect for the self-directed learning. The results of this analysis are presented in Table 2.

Table 2. Repeated Measure ANOVA

	SS	df	MS	F	P	η^2
Between-subject effects						
Group (G)	4354.742	1	435.742	10.99	.001	.126
Error	3009.818	76				
Within-subject effects						
Measurement (M)	5069.250	2	2534.6	39.97	.000	.345
M × G	3477.558	2	1738.7	27.42	.000	.265
Error	9638.280	152	63.410			

Based on Table 2, between-subject effects data show that in terms of self-directed learning, there is a significant difference between PoBL strategy group and CT strategy group, $F(1,76)=10.99$, $p<.001$, $\eta^2 =.126$. The within-subject effects data also indicated that there is a significant difference in the overall self-directed learning mean scores across the three sequencing measurements, $F(2,152)= 39.97$, $p<.001$, $\eta^2 =.345$. Table 2 also illustrates significant interaction between the three sequencing measurements and groups; $F(2, 152)=27.42$, $p<.000$, $\eta^2 =.265$. It is

observed that the magnitude of the differences in the means obtained were large. According to Pallant (2010), $\eta^2 = .01$ small effect, $\eta^2 = .06$, medium, and $\eta^2 = .138$ large effect.

Table 2 suggests that the increasing mean score of self-directed learning is dependent on the type of treatment groups (i.e. PoBL strategy and CT strategy). To aid in the interpretation of the interaction effect of the treatment and measurements, it would be useful to examine the graph presented in Figure 1.

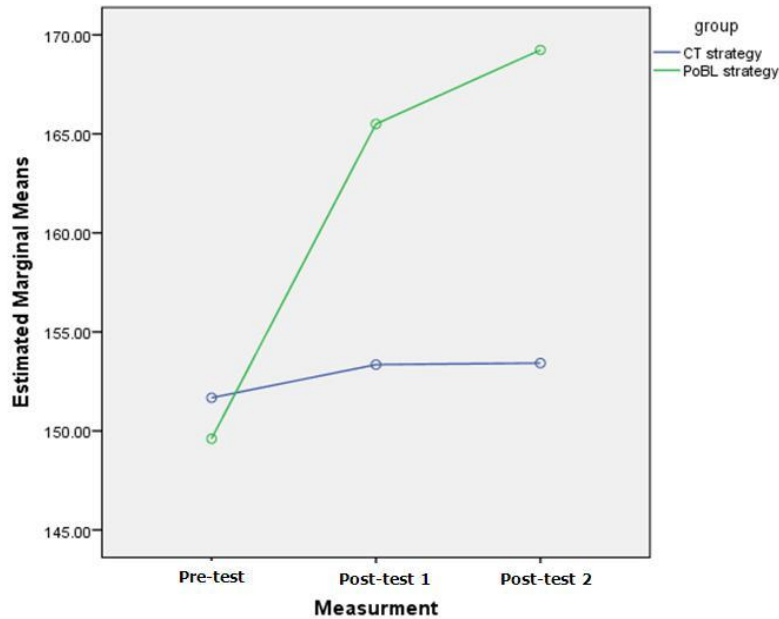


Figure 1. Estimated Marginal Means of Self-directed Learning

The above graph is plotted from the mean of self-directed learning presented in the Estimated Marginal Means Table of measurement and treatment interaction. Figure 1 shows that PoBL strategy helped students to improve their overall self-directed learning skills more than the CT strategy did.

Although there is generally an increase in the overall self-directed learning across the three sequencing measurements for two groups, the rate of the 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 revealed an overall significant difference in means, although it is not known where those differences have occurred. For this purpose, the Pairwise Comparison Test was used (see Table 3).

Table 3. Peerwise Comparison Test of Self-directed Learning

	Measurement	Mean Difference	Std. Error	Sig.
Pre-test	Post-test one	-8.758	1.439	.000
	Post-test two	-10.691	1.472	.000
Post-test one	Pre-test	8.785	1.439	.000
	Post-test two	-1.906	.802	.60
Post-test two	Pre-test	-10.691	1.472	.000
	Post-test one	1.906	.802	.60

Based on Table 3, it was observed that there is a significant difference in the mean of self-directed learning between the pre-test and the post-test one, $p < .000$. Furthermore, in terms of self-directed learning the difference between pre-test and post-test two was also significant ($p < .000$). Meanwhile, the results showed that the mean of self-directed learning between post-test one and post-test two was not significant ($p > .60$).

Discussion and Conclusion

The results of the present study demonstrate that students in the PoBL group performed better in their self-directed learning as opposed to those exposed to CT strategy. Based on the results, a significant difference was seen in self-directed learning between the two groups after training. Students in the PoBL group demonstrated a considerable improvement in all three measurements (pre-test, post-test one, and post-test two). Meanwhile, the progress in self-directed learning among the CT strategy class students was negligible. It is evident that project-based learning fosters the development of self-directed learning attitudes of learners. In the current study, project-based learners conducted some activities through which their abilities were improved in terms of time management, goal orientation, controlling one's own learning, a personal sense of responsibility towards other people's learning, self-assessment, decision making based on the information etc.

Students in the PoBL group were required to come up with a specific time table. Since each project goes through specific procedures and steps, the group members are required to provide an exact schedule for the implementation of each step as well as its due date. On the other hand, since the groups compete with each other, time optimization can be advantageous for them and improve the project's quality. In line with this strategy, the learners design subject-matter in terms of the course content, and then determine a time output and the project's procedures.

One of the advantages of project-based learning is that the learners themselves determine the project objectives; the learners select the projects according to their own interests and implement

the project according to the lesson's concepts. In PoBL, the group members assess their own and others' performance with the aim of enhancing the project; since the learners perform their own projects in groups, they need to establish rapport and work as a cohesive unit. The PoBL is a learning method based on reality, i.e. the students' projects are typically taken out of real-life situations. In the present study, the groups also selected their projects in terms of real-life situations. Since this study has been carried out among educational technology students, it was befitting that students select their own projects related to educational problems and try to design and implement their projects so that they had a chance to solve an educational problem. At all stages of the project, the students were obliged to make decisions based on the data they gathered from a real-life situation.

The nature of the projects naturally lends itself to student enjoyment. The projects, in most cases, are like puzzles which challenge the students. PoBL gives the learners a kind of inner satisfaction since they not only participate actively in the learning process, but also control and evaluate their own learning constantly. In traditional classes, the teacher transfers the information to the students through a one way process and the learners' role is a passive one. In contrast, PoBL naturally encourages learners to play a key role in all stages of the project, which increases their motivation to learn. Overall, it can be reasonably ascertained that the process of project-based learning paves the way for the development of self-directed learning skills among learners in higher education.

The integration of PoBL in the curriculum of educational technology has the potential to establish self-directed learning skills which consequently enable the learners to overcome their pedagogical needs and challenges. This study recommends that PoBL strategy as a pedagogical approach should be made a part of a routine which is readily-available for teachers to use in a classroom setting. However, in order to be effectively implemented, PoBL requires the presence of certain prerequisites, such as teachers' professional development, teachers' classroom management ability, the fulfillment of projects, evaluation techniques, and the integration of technology in teaching. In order to facilitate and increase the effectiveness of the execution of PoBL strategy, the following recommendations may be useful:

- The structure of the classroom and the equipment required for this method are different from those of traditional methods. Such differences include the seating arrangement of learners and equipment. PoBL is an educational approach in which technology is easily accessed and students gather, analyze, and interpret data effectively through technology and consequently present their interpretation to the classroom. Thus, it is recommended that PoBL strategy be administered in classroom contexts in which students are provided with computers and the Internet.
- The number of students should not be so large that the quality of students' supervision by the teacher is diminished at any time. For classes with larger numbers of students, the use of PoBL is not advised.

- PoBL requires a powerful network for cooperating with the outside environment. Going through formal procedures can be time-and energy-consuming, and may create an obstacle in the progress of projects. Some facilities need to be set up with this in mind.
- Appropriate lesson plans for projects are those that encourage problem-solving skills, critical thinking, cooperating skills, and communicative skills of learners. Teachers are therefore recommended to pay specific attention to these important skills in developing course materials.
- The successful execution of PoBL is strongly contingent upon learners' cooperation. The instructor must provide the students with an explanation of how the group works as well as other relevant skills such as showing respect to other students' views, allowing them to express themselves, and distributing tasks evenly among the group members. Teacher must also ensure that the conditions are set up in such a way that students of all levels of competency are able to participate in group activities and learning processes.

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