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THE IMPACT OF PROJECT-BASED LEARNING ON STUDENTS' ACHIEVEMENT IN MATHEMATICS

Project-based learning – one of the most effective methods of teaching students in our country and around the world. Today's society needs self-reliant, well-prepared high school graduates who can work independently. This method directs the students to learn through planning and independent performance of more complex tasks. Today, it is important to prepare children for a big life, encouraging them to see the fruits of their labor. According to Kyle Chard, with the successful implementation of project-based learning, students become more motivated and actively involved in life. The study was aimed to assess the project – based learning (PBL) activities' effects on student achievement. Two ninth-grade classes were randomly selected for experimental and control groups. Pre-test and post-test data were collected for measure of mathematics achievement. Data was analyzed using t-test. The results indicated a significant impact of peer instruction on achievement and an improvement in mathematic.

Keywords: education, mathematics, project-based learning, mathematics achievement.

Introduction

Project training is one of the teaching methods aimed at students in our country and around the world. That is one of the methods which can be used in students that are responsible for students' training, development, and availability. Teachers who work in school demonstrate that when studying is active, students will learn easier and will help inspire other students. At present, the teaching of mathematics discipline is one of the major problems in the school curriculum. Traditional education methods of teaching mathematics are teacher-oriented, which negatively impacts the knowledge of mathematics of the students. Many high school students are negatively impacted by traditional methods, according to Geist and King (2008) [1]. Regardless of that fact, the traditional method is still

used by teachers, taking a lot of time in talking rather than creating a conducive environment for effective peer learning.

The project method is an in-depth exploration of a real-world topic worthy of the student's attention and efforts (Chard, 2011) [2]. Project – based learning (PBL) is a teaching method in which students learn their valuable skills by doing real projects (Holubova, 2008) [3]. The project learning approach is teaching strategies that enable teachers to guide students through in-depth research in the real world (Chard, 2011). In Project Learning, students learn to take responsibility for their learning, this teaching helps students build a solid foundation on which they can work with others throughout their lives. This method places an emphasis on building a comprehensive unit around an activity that can be performed in or out of school (Pattnaik, Chakradeo and Banerjee, 2014) [4].

According to Knoll (1997) [5], project learning is considered a means by which students (a) develop independence and responsibility, and (b) practice social and democratic forms of behavior. Knoll noted that project learning was brought into the curriculum to help students learn at school, study independently, and combine theory with practice. The project method is a challenge-based, goal-oriented activity that promotes successful and efficient collaboration where students' activities gain more weight than information communication by the teacher (Szállassy, 2008, p. 49) [6].

Project-based teaching is imaginative throughout its focus on cooperative learning. Students also create tangible results to represent what they have managed to learn. To respond to a complex issue, problem or challenge, students use technology and inquiry. PBL focuses on student-centered independent review and group studying, as referred to this one in control, with the teacher acting as advisor. Activities match the real-world tasks of professionals as nearly as possible instead of classroom-based tasks. This motivates academic interpretations and allows learners to perform different roles and develop knowledge that can be implemented more than a single well-defined approach. Finally, it enables for a range and variety of results that are aware of the different approaches, instead of a single correct response by implementing preset rules and regulations.

Project method is covered under different topics such as Project study, Project approach and Project-based learning and is considered as one of the basic teaching methods. Project learning is an action-centered and student-oriented learning initiative in which students are involved in practical problem solving for a specific period of time. Projects in Physics, for example, can consist of the construction of a meter bridge, a surge tank, the design of a DC engine, or the shooting of a moving video film. Often, projects are initiated by the teacher, while planning and execution are given to students, individually or in groups. Unlike traditional

methods, projects focus on implementing, not giving. Implementing and focusing on specific knowledge or skills, and are more rigorous than demonstration, knowingly lecturing to promote intrinsic motivation, independent thinking, self-confidence and social responsibility (Knoll, 2014) [7].

When you successfully implement project learning, teachers and learning students are motivated and actively involve themselves and grow as individuals and collaborators in producing high quality work that helps them (Chard, 2011). However, information is not obtained sequentially in project learning, and if it is not well planned and executed properly, it may not be completed in time. These are some of the disadvantages of the project learning method claimed by Pattnaik, Chakradeo and Banerjee (2014).

Projects are used as a teaching tool in education and in achieving results and gaining various skills (Holzbaur, 2010) [8]. Holzbaur also argues that projects are a powerful method for teaching, training and research in education. However, Holzbaur also noted that there was much effort in the planning and execution of projects, along with academic and pedagogical challenges that required a systematic approach.

The role of the teacher in project learning should be a friend, guide and working partner. The teacher must learn with the students and not pretend to know everything (Pattnaik et al, 2014) [9]. If Project Learning is well planned and successfully implemented, it has many benefits, some of which encourage cooperative activity; engage and sustain students; and develop scientific attitudes.

Increased Academic Achievement

When students actively participate with PBL, research indicates that their academic achievement progresses across a variety of subjects and grades (Kaldi, Filippatou, & Govaris, 2011; Karacalli & Korur, 2014; Uyangor, 2012; Yetkiner et al., 2008). For example, research by Kaldi et al. in 2011 studied 4th grade of the student group as they took part in PBL method. They discovered that the mathematical ability of students increased after participating in the PBL unit after a pre-and post-test of content knowledge and individual interviews (Kaldi et al., 2011) [10].

Furthermore, without an experimental group, it is not evident whether or not students would have encountered a similar increase in knowledge through traditional methods, such as specific instruction, or whether the findings were the result of learning the information through PBL.

Additionally, Karacalli and Korur (2014) [11] also analyzed the impacts of PBL on the academic performance and understanding retention of fourth grade students. To use pre-and posttests, a control group that learned through traditional methods, and an experimental group using PBL, it was discovered that by the end

of the unit the students involved in PBL showed significantly greater improvements in their academic performance than the control group.

The students who studied through PBL also retained the information over a period of time much better than the students who learned through more traditional methods (Karacalli & Korur, 2014). The influence of a control group that learned through traditional educational strategies clearly indicates that PBL engagement can be attributed to the increase in academic performance.

Improved academic performance throughout subjects has been described as an advantage of PBL, but is also highly important in the context of mathematics. For example, after taking part in project-based mathematics, Cross et al. (2012) [12] discovered that the understanding of mathematical and statistical principles and operations by upper elementary students improved. Similar results were discovered by Uyangor (2012) [13] who showed significant differences in mathematics performances of high school students as a result of interacting in project-based mathematics between pre-and post-tests. Generally, the academic performance of students involved with PBL is significantly higher when considering mathematics performance on standardized tests than students who did not practice with PBL mathematics method.

Purpose of the study

The study aimed to investigate the impact of PBL on students' achievement.

Research Questions

Is there any effect of project-based learning on students' achievement in Math?

Methodology

Participants

PBL and standard training groups were selected based on pre-determined classes. These classes were determined by the enrollment of students, as well as the administration and location of teachers. The PBL group consisted of 18 students, of whom 8 were female and 10 were male. The standard group of studies consisted of 17 students, of whom 9 were female and 8 were male. The age of students ranged from 16 to 18 years.

Lesson Design

One of the goals of this study was to teach the same material in two different ways: using traditional lecture-based instructions with a standard group of training and project-based teaching methods with a PBL group. These lessons should have been held during the same time period.

The standard group training lessons were conducted using the traditional approach. This included reviewing the previous day's homework, then presenting the new material and completing the homework with 20–30 tasks. The new material

was presented using lecture instructions, which included examples of the problems that they would see in their homework and the formulas needed to solve these problems. The parts needed to calculate the area formulas were outlined, and the examples included forms that were oriented differently.

PBL group lessons were project- based and had specific tasks for each day to keep the PBL group abreast of the standard training group. Students from the PBL group solved the same typical tasks, but were trained completely differently than the standard group of studies. PBL is a multifaceted activity that includes observation; posing questions; studying books and other sources of information to see what is already known; investigation planning; analysis of what is already known in the light of experimental data; using tools to collect, analyze and interpret data; offer answers, explanations and predictions; and reporting results. PBL requires the identification of assumptions, the use of critical and logical thinking and the consideration of alternative explanations. PBL methods for learning are based on focused student research and encourage community-based learning through discussion and current practical tasks. These assignments helped students in their work to identify specific mathematical relationships and understanding. PBL lessons were taught in lightweight group work with the expectation that students would work with members of their group to develop methods for the area formulas. As an instructor, we closely followed the process of individual groups and demanded that all participants substantiate their methods. We have carefully developed lessons to allow students to move from a developed method for finding simple environments for formulating, to more complex problems that required using a developed method to search for area. The class gradually turned to more complex forms; students had to use previous studies to find areas of these forms. The lessons were designed to involve students in developing their own strategies for formulating areas that are consistent with the basic principles of constructivist learning.

At the end of each lesson, students were offered a task that needed to be taken home and completed using the newly developed method. These sets of problems were short (consisting of three to five tasks) and served only to consolidate the developed understanding.

Lesson Progression

Area topics taught in this unit were taught in the order presented in Table1.

Table 1 – Lesson Progression

PBL group	Standard learning group
Area of parallelograms	Area and perimeter of rectangles, squares, and circles

Area of triangles	Area of triangles and parallelograms
Area of trapezoids	Area of trapezoids, rhombuses, and kites
Area of rhombuses and kites	Review of formulas covered so far
Perimeter and area of similar figures	Perimeter and area of similar figures
Circumference and arc-length	Circumference and arc-length
Areas of circles and sectors	Areas of circles and sectors

Results

Pre-Test

The study began with the completion of the pre-test by all students in both standard training and PBL groups. Students who did not return the consent form were excluded from the final analysis. The scores of the standard study group and the PBL group were compared to obtain a basic indicator of students' knowledge. The test score was found for each group. A t-test was then performed to evaluate differences in estimates not related to randomness. The results can be found in table 2.

Table 2 – Pre-test Results

Groups	Test	N	Mean	SD	Df	t-value	p-value
Control group Experimental group	Pre-test Pre-test	17 18	39.52 38	15.35 14.77	33	0.29	0.66

Post-Test

After the treatment period, a post-test was performed. An analysis of the average scores after testing for the two groups can be found in Table3. One of the significant factors for the post-test was the lack of students at the test date. Some students from the experimental and control groups were absent from school activities and could not make up a test for up to 3-5 days after the actual test date. These estimates were excluded from the final post-test analysis, as their results would require a higher retention rate. The delay was reviewed later in the semester. It seems more appropriate to include only comparable data, which will be limited to tests conducted within a reasonable time of each other.

Table 3 – Post-test Results

Groups	Test	N	Mean	SD	df	t-value	p-value
Control group Experimental group	Post-test Post-test	17 18	63.35 86	15.24 14.94	33	-4.43	0.028

Table 4

Groups	Test	N	Mean	SD	Df	t-value	p-value
Control group Control group	Pre-test Post-test	17 17	39.52 63.35	15.35 15.24	32	-4.52	0.000

Table 4 shows that the arithmetic mean score of the pre-test students was 39.52 and their post-test mean score was 63.35. Test assessment showed t (32) = -4.52. The control's post-test mean score (63.35±15.24) was substantially higher than its pre-test mean score (39.52±15.35). The «p» value (0.000) was lower than the meaning level of 0.05, showing a statistically significant difference between the pre-test-post-test achievement mean scores of the control group. The difference was in favor of the control group's post-test mean scores, indicating that regular class teacher instruction in teaching measurements also affected the academic achievement of students.

b) Is there a statistically significant difference between the mean scores obtained by PBL (experimental) students in math courses between pre-and post-test? To answer this question, the experimental group calculated pre and post-test mean scores and standard deviation values, and t testing was used to test the meaning of the difference between their pre and post-test scores. Table 5 shows the pre- and post-test mean scores attitude of the group, standard deviation and t values.

Table 5

Groups	Test	N	Mean	SD	Df	t-value	p-value
Experimental group Experimental group	Pre-test Post-test	18 18	38 86	14.77 14.94	34	9.69	0.000

As shown in the table, the arithmetic mean score of pre-test of experimental students was 38 and the mean score of the post-test was 86. Simultaneously, t (34) = 9.69. The experimental group's post-test mean score (38±14.77) was substantially higher than its pre-test mean score (86±14.94). The «p» value (0.000) was lower than the meaning level of 0.05, showing a statistically significant difference between the mean scores of the pre-test-post-test performance of the

experimental group. The difference was in favor of the experimental group's post-test achievement mean scores. These findings show that the use of PBL in measurement teaching positively affected the academic achievement of students.

Based on the findings from problems a and b, it is clear that mathematics students' academic achievement was positively affected by instruction in both experimental and control groups. It was also found that both groups within themselves had a significant difference between the mean achievement scores.

c) Does the mean post-test scores obtained by experimental and control groups differ significantly? The answer was decided by examining the post the mean scores and standard deviations of the experimental and control groups on the test, and by using t test in order to see the significance of the difference. Table 6 presents the post-test mean scores, standard deviations, and t values.

Table 6

Groups	Test	N	Mean	SD	df	t-value	p-value
Control group Experimental group	Post-test Post-test	17 18	63.35 86	15.24 14.94	33	-4.43	0.028

As shown in the table, the test was carried out as a post-test in both experimental and control groups to find out if instruction with problem-based learning and regular instruction made a difference in the math achievement of the students and the experimental group's arithmetic mean was 86; and that in the control group was 63.35. The mean score of the experimental group (86$\pm$14.94) was significantly higher than the mean score of the control group (63.35$\pm$15.24). T test was used to examine whether there was a significant difference between the post-test performance scores and the result was t (33) = -4.43. This indicates that the use of PBL to teach measurements in the control group was more influential in bringing academic achievement than the regular instruction given without intervention in the control group.

Conclusion

The first question of research addressed the perceptions of the students towards project-based learning. The perceptions of the students towards project-based learning were very positive, according to the results. To examine the perceptions of students towards project-based learning, there were 10 items. Study results show that students learned more formulas through project-based learning compared to traditional learning methods (more than 70% of students responded strongly and agreed) and experienced an increase in learning motivations while at the same time adopting more positive attitudes towards learning.

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О. К. Нурбавлиев, С. Каймак, А. Алмас

Влияние проектного обучения на достижения студентов в математике

Университет имени Сулеймана Демиреля,
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Жобалық оқыту – бұл біздің еліміздегі және бүкіл әлемдегі оқушыларға бағытталған оқыту әдістерінің бірі болып табылады. Қазіргі қоғамға өз бетінше жұмыс істей алатын, өз-өзіне сенімді, дайындығы жоғары орта мектеп түлектері қажет. Бұл әдіс оқушылардың жоспарлау және күрделене беретін тапсырмаларды өз бетінше орындау арқылы меңгеруге бағыттайтын білімі. Балаларды өз жұмысының жемісін көруге ынталандыру арқылы үлкен өмірге дайындау қазіргі заманның өзектілігі.Ғалым Кайл Чардтың айтуынша жобалық оқытуды ойдағыдай жүзеге асырған кезде оқушылардың ынтасы артыпөмірге белсенді араласа бастайды.Зерттеуіміз жобалап оқыту негізінде оқушылардың оқу жетістіктеріне әсерін бағалауға бағытталған. Екі тоғызыншы сыныптар эксперименттік

және бақылау топтары үшін кездейсоқ таңдалды. Математика жетістіктерін өлшеу үшін тестке дейінгі және тесттен кейінгі мәліметтер жиналды. T-test көмегімен деректер талданды. Нәтижелер құрдастарының нұсқауының математика жетістіктері мен жетілуіне айтарлықтай әсері бар екенін көрсетті.

Кілтті сөздер: педагогика, математика, жобалық оқыту, математика жетістіктері

Проектное обучение – один из самых эффективных методов обучения студентов в нашей стране и во всем мире. Современное общество нуждается в самостоятельных, хорошо подготовленных выпускниках средней школы, способных работать самостоятельно. Этот метод направляет студентов освоить путем планирования и самостоятельного выполнения более сложных задач. Сегодня актуальной является подготовка детей к большой жизни, побуждая их видеть плоды своего труда. По словам ученого Кайла Чарда, при успешном внедрении проектного обучения студенты становятся более мотивированными и активно участвуют в жизни.Целью исследования было оценить влияние деятельности по проектному обучению (PBL) на успеваемость учащихся. Два девятых класса были выбраны случайным образом для экспериментальной и контрольной групп. Данные до и после теста были собраны для оценки достижений в математике. Данные были проанализированы с использованием t-критерия. Результаты показали значительное влияние обучения сверстников на достижение и улучшение математики.

Ключевые слова: образование, математика, проектное обучение, математические достижения.

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