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A PROJECT BASED LEARNING OF TEACHING GEOMETRY IN A 7TH GRADE

Abstract. Project-based learning is a teaching method that supports students' concrete understanding of abstract mathematical concepts. The method engages students' interest and curiosity by allowing them to complete projects that relate to real-world situation. This method of learning requires teachers to plan and develop projects that encourage students to work individually skills and present projects to their peers. Project-based learning was implemented in a 7 grade classroom.

The aim of this study is to examine the effects of the Problem-Based Learning(PBL) approach on students' performance in the learning of geometry The participants were 23 students from 7 grade classroom in Bilim Innovation lyceum for gifted girls in Pavlodar. A mixed method design was employed with data collected from the pre-, post- and retention tests, and interviews. The findings from this study revealed positive influences on students' performance in learning geometryas gain and retention of knowledge was observed.

Keywords: geometry, project based learning, mathematical concepts, method.

Introduction. In the 1960s, McMaster University in Canada developed Problem-Based Learning (PBL) to help medical students learn more effectively [1]. PBL is a student-centered learning environment in which students develop their own knowledge and collaborate to solve issues that motivate them to learn. With him or her acknowledging the pupils' efforts, ideas, and past knowledge, the instructor encourages learning [2-6]. Students are expected to participate in collaborative efforts to address problems in PBL [7]. PBL has been used in a variety of research studies around the world and has sparked debate among educators, psychologists, and academics. The core feature of PBL, according to Barrows and Tamblyn [1], is founded on social constructivism. Several PBL approaches for student-centered, problem-based, collaborative learning have been created since its implementation. Given the abundance of empirical evidence demonstrating the benefits of PBL over traditional teacher-centered instruction, there has been widespread adoption of PBL at all levels and across all subject areas.

The benefits of PBL.

PBL has been applied and developed as a student-centered learning technique at a variety of educational levels [8]. One of them is the usefulness of the PBL technique in learning, particularly in terms of improving information or knowledge retention [9]. PBL allows students to collaborate and develop knowledge through social interaction, as opposed to traditional teaching approaches [10-12]. One of the most important aspects of PBL that might affect learning outcomes and motivation is group composition [13]. In a PBL course, the small group structure helps spread cognitive tasks among group members [14]. Small group discussions in PBL sessions have also been shown to improve problem solving and higher-order thinking, as well as encourage shared knowledge development [15].

PBL has been shown to be beneficial in enhancing students' mathematical understanding in previous studies [10]. Based on their pre- and post-test results, Botti et al. [11] showed improvements in students' math proficiency. This demonstrates that PBL implementation can have a favorable impact on students' growth in areas such as real-life and syllabus-based knowledge.

Learning geometry by PBL.

In a geometry session, teachers typically explain to students the qualities related with geometrical shapes and properties, and then require students to perform the supplied exercises to determine whether they have grasped the content or are merely responding from memorization [15]. Few attempts were made to encourage students to clarify their reasoning and create logical connections. Students' thinking and geometrical senses must be developed, and they will need a thorough comprehension of the facts of geometry to do so. This issue can be addressed utilizing a variety of teaching methods, such as PBL, which can assist students in understanding the essential links between geometrical principles and transdisciplinary concepts in other areas of mathematics [4]. This is to guarantee that students obtain a thorough comprehension of the concepts and processes, rather than simply memorizing the rules. This will help pupils remember their knowledge and skills while also giving them confidence while completing new arithmetic problems.

Guiding and research questions.

The study will address the following guiding and research questions

Guiding Question:"What aspects of project-based learning (PBL) effect students' performance in geometry?"

Research Question 1: What effect does the use of technology in PBL have on students' understanding of geometry concepts?

Research Question 2: How does hands-on experience in PBL when practiced by students show an impact on students' comprehension of mathematical concepts?

Research Question 3: How does students' understanding of mathematical concepts improve as a result of their hands-on experience in PBL?

Research Question 4: What do students think is the most important aspect of PBL in terms of learning mathematical concepts?

Conditions and methods of research. The goal of PBL is "a greater understanding of a topic, deeper learning, higher-level reading, and an increased motivation to learn" (Bell, 2010). Helping pupils integrate and apply mathematics concepts is an important aspect of teaching geometry in the school system. According to studies, the mathematic curriculum in primary and secondary schools presents a significant challenge for children understanding geometry ideas. According to several polls conducted in U.S. schools, roughly 30% of pupils who finished a full year of geometry. Only around 75% of these students have mastered the geometry curriculum. In many public schools, traditional lecture and note-taking methods are used to teach geometry. Students who have been exposed to this way of teaching geometry have had poor academic results. When students are exposed to more creative techniques of teaching geometry, their curiosity is piqued, and their attitude toward learning mathematics improves. PBL approaches comprise the basic abilities required to support student learning experiences, and they serve as the foundation upon which geometric topics are taught and learned.

Geometry must be provided to students in the early years of secondary school in an engaging, clear, and meaningful manner in order to give pupils the opportunity to study spatial concepts and real-world problems. Geometry is intended to teach spatial awareness, geometric intuition, logical reasoning, and the application of

geometry in the real world through modeling and problem-solving skills. PBL encourages students to design their own work in the classroom using geometric concepts gained in the mathematics curriculum. The main idea behind using the PBL model to teach geometry is to incorporate learning with real-life problems, achieve a connection between the learner's cognition and professional knowledge and the problems, learn in small groups, and allow the teacher to assist the students as a facilitator rather than a leader. PBL methods in the academic sphere can assist pupils apply what they've learned about geometry.

The study's goal was to see if project-based learning activities improved students' geometry performance and engagement. I hoped to gain a deeper understanding of how project-based learning in my classroom affects students' progress through an action research study. A combination of quantitative and qualitative research techniques were used in the study. Face-to-face interviews, document evaluation of reflection from students' portfolios, observation of students'interactions, analysis of student performance on geometry understanding, and t-testanalysis were utilized to collect data for this study.

The sample consisted of 23 students from 7 grade classroom. The topic of the intervention lessons (PBL lessons) was circle, parts of a circle and its properties, which was included in the 7 grade geometry syllabus i. The PBL lessons were conducted over a period of two weeks, and met one times a week. The first author, who implemented all the PBL lessons during the course of the intervention, also designed the PBL lessons. The PBL model by Lee and Bae [15] was adapted to design the PBL lessons (see Figure 1).

Lesson 1: Introduction, Understand the Problem, and Searching for Information (on-going)

→ Students are introduced to understand and analyse the given problem.

→ Students make inquires and perform searches individually or collaboratively to gain understanding of the problem.

→ Facilitator monitors students' progress and make sure that they are on the right track.

Lesson 2: Construct and Gather Solution

→ Students gather all the necessary information, and discuss to produce a draft of their possible solutions to solve the given problem.

Lesson 3: Presentation and Reflection

→ Students prepare for a 5-7 minutes presentation to share their findings in front of the whole class.

Figure 1. PBL lesson intervention design.

The PBL intervention enables students to solve the PBL challenge in groups of four or five students [14]. In this study, there were five groups of students, and each group had to choose a leader, a writer, and a presenter to guarantee that thejobs were spread equitably among the participants. Each group received a PBL Activity Booklet. A cover page, the PBL model [15], a created problem, a PBL FactsList, and blank A4 papers to record the conclusions were all included in this booklet.

During the courses, students were given a PBL challenge (see Figure 2) that provided them with a real-life situation that they had not before encountered in class.

How to Fix a Broken Piece Ceramic Plate?

Aysha discovered a broken piece of an antique ceramic plate during a geography fieldtrip, and she believes the plate is circular. Sarah understands she needs to find the radius of the broken plate in order to build a replica of the full plate for her geography project, but she has no idea how to do so. Can you and your team assist Sarah in determining the radius of the broken plate in a step-by-step manner?

It's your job to come up with compelling solutions (step-by-step instructions) for determining the radius of the fractured plate. Remember that you are not necessary to find the exact value (radius length) for this job. You must give a presentation to discuss your findings and provide justifications.

Figure 2. The PBL

The PBL challenge is designed to allow students to tackle it in a variety of ways. The content was carefully crafted as a difficulty, as Li [1] suggested. Furthermore, the PBL challenge was created with three key characteristics in mind: it was poorly structured, contextualized, and related to real-life events [4].

The students were encouraged to engage in active group dialogues in which they articulated their thinking for addressing the challenge. Each group was also handed notepads so that students could write down all of their questions, which would be addressed later during the facilitating process. After the students had grasped the problem's background, they were asked to identify the problem's statement, such as what information is provided and what information is required. These were then entered into the PBL Facts List, which had been modified. The information-gathering phase spanned a full 30-minute lecture, during which students looked for appropriate materials to help them solve the problems. They were also expected to use and evaluate a variety of resources, such as a textbook and a notepad. This was done as a continuous procedure, with kids completing the assignment at home after school. The students collaborated in the following lesson to analyze all of the information they had gathered and create a draft of their approach and strategies for tackling the challenge. At this point, the students examined the findings of their peers and decided on the best approach and strategies for resolving the problem. When all of the group members had finished their findings suggestion, the presentation began. Each group was assigned a presenter to give a 5- to 7-minute presentation on their concept. Each student was also given a reflection sheet on which to rate his or her peer's overall presentation. After each presentation, a whole-class discussion was held to allow for interactions and constructive input, followed by a wrap-up session [9].

The goal of the pre- and post-tests was to see if there were any differences in the students' academic achievement after the PBL classes were completed. The pupils were given the post-test roughly a week after the pre-test was delivered. The same pupils were given the retention test questions again after a break of around four weeks. The major goal of the retention test was to see how much knowledge the pupils had retained from the intervention lessons. Each of the three test instruments had seven items. The test items consisted of questions that tested the students' prior knowledge of basic geometrical terminology, geometrical representation skills, and circular parts and attributes. Each question was given a score out of 11 for a total of 25 points, and the test was allowed 25 minutes to complete.

Semi-structured interviews. In general, semi-structured interviews were used to obtain students' viewpoints on their understanding, learning attitudes, and learning challenges [14]. There were three solo interviews and three group interviews, each with five, five, and two students. Each interview lasted approximately 10 minutes. All of the interviews were done in strict confidence and with proper interview etiquette. Pseudonyms were employed to replace the students' names while reporting the results. All of the interviews were taped and transcribed for further examination.

Research results. The effects of the PBL approach on students' performance in the learning of geometry. To see if there were statistically significant differences in the mean scoresbetween the pre- and post-tests, non-parametric methods such the Wilcoxon Signed Rank Test[13] were used. The average mean scores of the students in the post-test increased slightly after the comparisons presented in Table 1.

Table 1

Mean scores for the pre-,post-tests

	Pre-test (N=23)	Post-test (N=23)
Avarage mean scores	8.81	9.19

The Wilcoxon test results (see Table 2) reveal that none of the students scored poorly during the post-test. Seven pupils improved their grades, while the other eight maintained theirs. Furthermore, with a medium effect size (r =.44), the test revealed a statistically significant change in mean scores between the pre-test and post-test (z = 2.43, p = 0.015). According to Pallant [36], the best way to compute the effect size for the Wilcoxon test is to divide the critical-z value by the square root of N, where N is the number of samples spanning the two time points $r = \frac{Z}{\sqrt{N}}$

Table 2

Analysis using Wilcoxon Signed Ranks test (N=21)

	Negative ranks	Positive ranks	Ties
Post-test – Pre-test	3	8	10

Questions 1 and 2(a) of the test instrument tested the students' abilities to recognize the line of symmetry as well as essential terminology such as diameter, radius, and chord. The students' ability to recognize the geometric attributes of circles was tested in Questions 2(b) and 5(a), while their geometrical procedural skills in computing unknown central angles was tested in Questions 3, 4 and 5(b). Table 3 shows how the percentages of right replies in each question were compared**.**

It's worth mentioning that all questions saw an improvement in correct percentage response: in the post-test, 95.3 percent of students properly answered Questions 2(b) and 5(a), a 9.6 percent gain over the pre-test findings. This demonstrated that the students' geometrical representation abilities had improved. Examining the students' responses to Question 2(b) during the pretest, it was discovered that the majority of the students did not submit any answers, and those who did provided wrong solutions. In the post-test for Question 2, however, there were more students who had accurate answers (b). The capacity of pupils to recognize the geometrical representation appeared to be strongly linked to an increase in the mean percentage of Question 2(b).

Table 3

Comparisons of percentages of correct responses in the pre- and post-tests

Areas	Questions	Percentage of correct responses (%)	
		Pre-test	Post-test
Prior knowledge	1 and 2	77.4	78.6
Geometrical representations	7 and 5	85.7	95.3
Procedural skills	3,4 and 6	59.5	67.5

Discussion of scientific results. During the interviews, students shared their personal insights on PBL experience in terms of learning attitudes, learning difficulties, and knowledge and skills. Data from video-recordings of classroom observations and the teacher's notes were also used to support the findings obtained from the interviews with the students.

In order to determine which learning style the students preferred, they were asked if they liked the PBL technique or the traditional method in general. Mixed reactions were observed during the student interviews. PBL was preferred by several students because they believed it would equip them with valuable skills and a higher degree of knowledge acquisition.

Conclusion. This study found evidence that students' learning and perspectives on PBL were positively changed when PBL was implemented in the context of learning geometry. During the post-test, the Wilcoxon test results demonstrate a considerable improvement in students' mean scores. Students liked the PBL because of the experience of independent learning and the growth of communication and research abilities that they saw during the learning process leading up to the group work presentations.

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7-СЫНЫПТА ЖОБАЛЫҚ ОҚЫТУ АРҚЫЛЫ ГЕОМЕТРИЯНЫ ОҚЫТУ

Аңдатпа. Жобаға негізделген оқыту - бұл оқушылардың абстрактілі математикалық ұғымдар туралы нақты түсінігін қолдайтын оқыту әдісі. Бұл әдіс оқушылардың қызығушылығы мен қызығушылығын тудырады, оларға нақты жағдайға байланысты жобаларды орындауға мүмкіндік береді. Оқытудың бұл әдісі мұғалімдерден оқушыларды жеке жұмыс істеуге және өз құрдастарына жобаларды ұсынуға шақыратын жобаларды жоспарлауды және жобалауды талап етеді. Жобалық оқыту 7-сыныпта жүзеге асырылды.

Бұл зерттеудің мақсаты проблемалық-бағдарланған оқыту тәсілінің (ТжКБ) оқушылардың геометрияны оқудағы үлгеріміне әсерін зерттеу болып табылады. Павлодардағы қыздарға арналған "Білім инновация лицейі" 7-сыныптың 23 оқушысы қатысты. Аралас әдіс дизайны бұрын, кейін және ұстап тұру сынақтарынан, сондай-ақ сұхбаттардан жиналған мәліметтермен қолданылды. Бұл зерттеудің нәтижелері геометрияны оқудағы оқушылардың үлгеріміне оң әсерін көрсетті, өйткені білім алу және есте сақтау байқалды.

Тірек сөздер: геометрия, жобалық оқыту, математикалық түсінік, әдіс

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ПРЕПОДАВАНИЕ ГЕОМЕТРИИ ЧЕРЕЗ ПРОЕКТНОЕОБУЧЕНИЕ В 7 КЛАССЕ

Аннотация. Обучение на основе проектов — это метод обучения, который поддерживает конкретное понимание учащимися абстрактных математических

понятий. Этот метод вызывает интерес и любопытство учащихся, позволяя им выполнять проекты, связанные с реальной ситуацией. Этот метод обучения требует, чтобы учителя планировали и разрабатывали проекты, которые побуждают учащихся работать индивидуально и представлять проекты своим сверстникам. Проектное обучение реализовано в7 классе.

Целью данного исследования является изучение влияния подхода проблемно-ориентированного обучения (ПОО) на успеваемость учащихся в изучении геометрии. Участниками стали 23 ученицы 7-го класса “Білім инновация лицей” для девочек в Павлодаре. Смешанный дизайн метода был использован с данными, собранными из тестов до, после и удержания, а также из интервью. Результаты этого исследования показали положительное влияние на успеваемость учащихся в изучении геометрии, поскольку наблюдалось получение и сохранение знаний**.**

Ключевые слова: геометрия, проектное обучение, математическое понимание, метод.