Research Article

Indian Journal of Science and Research

Minn KMM. & Tin HHK., Ind. J. Sci. Res. 2026, 6(3), 158-164

ISSN 2583 – 2913

STUDENT PREFERENCES TOWARD PROJECT-BASED LEARNING IN MATHEMATICS

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Abstract: To foster critical and analytical thinking skills in students, mathematics education is crucial. However, traditional methods emphasize memorization and repetition, making students lose interest in participating in mathematics classes. Project-based learning (PBL) refers to an educational approach in which learners are encouraged to engage in various activities, including creative learning, collaboration, and real-life implementation of theoretical aspects in mathematics. The current research paper examines the choice of students regarding project-based activities in mathematics disciplines. This paper attempts to explore whether mathematical projects encourage students' motivation, learning process, interest, and academic performance. For that reason, a survey methodology was used, and 100 students were carefully chosen from secondary and university-level institutions. The data collection procedure included the use of questionnaires, while the information was evaluated via factual statistics. The results suggest that most students choose project-based activities because such an approach helps them gain conceptual knowledge, teamwork abilities, creativity skills, and apply mathematics in practice. In addition, students indicated that mathematical projects help them avoid fear and anxiety in dealing with complex aspects in mathematics.

Keywords: Project-Based Learning, Mathematics Education, Student Preferences, Active Learning, Mathematical Projects.

Introduction: Mathematics is among the most crucial academic disciplines since it facilitates advancement in science, technology, and analysis. However, learners view mathematics as a challenging, dull, and stress-related subject due to conventional teaching methods used by educators. Learners spend most of their time solving problems from textbooks without relating mathematics to real-life experiences.

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DOI: https://doi.org/10.5281/zenodo.21320923

Article recived on: 24 May 2026

Published on web: 10 July 2026, www.ijsronline.org

Project-Based Learning has emerged as a novel way of teaching aimed at making the learning process more engaging and effective. The application of PBL in mathematics enables learners to apply various concepts, formulas, and computations to practical aspects such as budgets, statistics, designs, business plans, and experiments in science.

PBL fosters cooperation, collaboration, critical thinking, and creativity. Students do not rely on the rote learning process but engage in experiments, presentation, survey, data computation, and technology to facilitate learning. Such forms of PBL increase learners' involvement and encourage independent learning.

The main focus of the research will be the preferences that students have towards project-based learning in mathematics subjects. The study aims at assessing whether learners like mathematical projects, impact of projects on learners, and most liked types of mathematics projects.

Proposed Related Works: Many researchers have investigated the application of project-based learning (PBL) in mathematics education. According to Thomas,[1] project-based learning increases student engagement and improves conceptual understanding. Bell[2] stated that PBL helps develop communication and collaborative skills while also motivating learners in the classroom.

Blumenfeld *et al*.[3] observed that students become more active learners when mathematical knowledge is applied to solve real-world problems. Kokotsaki *et al*.[4] emphasized that PBL stimulates critical and creative thinking among students in STEM disciplines. Holmes and Hwang[5] concluded that mathematics projects enhance problem-solving abilities and reduce students' anxiety toward mathematical calculations.

The integration of technology into mathematics projects has also received considerable attention in recent literature. Hernández-Ramos and De La Paz[6] demonstrated that the use of technology and statistical software significantly improves students' ability to analyze information from a mathematical perspective. Furthermore, Lee and Lim[7] found that collaborative mathematics projects positively influence academic achievement and teamwork skills.

Although previous studies have primarily focused on the educational effectiveness of project-based learning, there remains a need for research examining students' preferences regarding different types of mathematics projects.[8,9]. This is what this work seeks to achieve.

The purposes of this study are:

1. To analyze student preferences toward project-based learning in mathematics.
2. To identify the benefits of mathematical project activities.
3. To examine how projects influence student engagement and understanding.
4. To determine the most preferred types of mathematics projects among students.

Research Approach

Research Strategy: Quantitative and descriptive research projects were used in this research for exploring the attitudes of students towards mathematics projects. Quantitative procedure was chosen because it helps the researcher obtain data about the participants that is numerically measured and analyzed statistically. On the other hand, descriptive investigation design was ideal for the study since the learning was more concerned with the attitudes, interests, experience, and perception of the students regarding mathematics projects.

The objective of the study was to investigate the effect of project-based learning on students' motivation, comprehension, participation, creativity, and problem-solving skills in relation to mathematics subjects. Another portion that was analyzed included finding out which types of mathematical projects students prefer and what difficulties they face when performing the project tasks. Using survey questionnaires, the academics learned an efficient way of obtaining structured data from participants from various educational stages. A cross-sectional analysis design was used in conducting this research since all the data were gathered at one moment in time. This made it possible for the researchers to make comparisons between opinions and preferences expressed by the respondents, without engaging in extensive observation over an extended period.

Environment for conducting the study consisted of secondary schools and universities where math subjects were normally taught. Simple random selection approach was used to choose the respondents to avoid any bias in selection. Data was presented in tabular form and analyzed through percentage analysis and descriptive statistics. Research validity has been ensured by designing the items of the questionnaire based on findings of previous educational research works conducted on project-based learning and math subjects teaching. Ethical companies have also been considered during conducting research. Participation of students in the findings has been purely voluntary.

A total of 100 students participated in this study. The applicants involved secondary school students and university students studying mathematics-related subjects in table 1 and figure 1.

Table 1. A total of 100 students participated

Participant Group	Number of Students
Secondary Students	55
University Students	45
Total	100

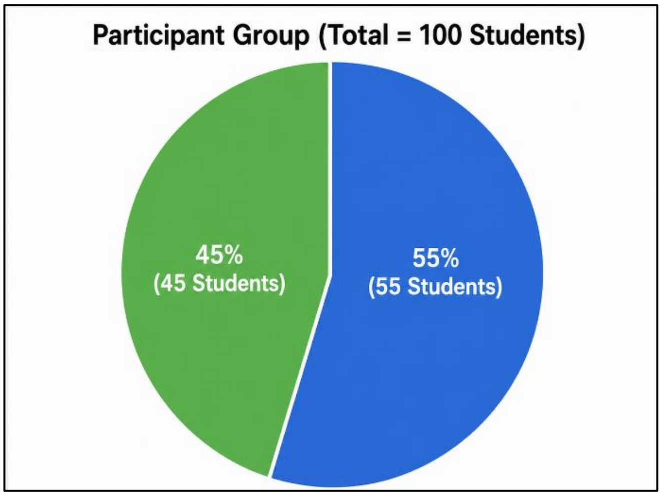

Figure 1. A total of participants

The members were selected from different educational establishments to gain diverse opinions on the topic of project-based learning as applied in mathematics. The secondary school students were included in the sample because they deal with the basics of mathematics and participate in projects in class, whereas university students were selected because they had knowledge of higher mathematics and carried out research-type projects. Various types of students in terms of education, abilities, and level of mathematical expertise were considered for conducting research to have a clearer idea of how students perceive mathematics projects. Members from both genders worked part in the survey voluntarily after being familiarized with the goal of research prior to answering questions.

Data Collected works: Data were composed using structured questionnaires consisting of multiple-choice and Likert-scale questions. The questionnaire focused on:

- Interest in mathematics projects
- Preferred project types
- Learning effectiveness
- Teamwork experiences
- Challenges faced during projects

Data Analysis: Percentage analysis and descriptive statistics were the approaches employed in analyzing the data. Following data collection, the information was then structured in a systematic manner to facilitate an easy analysis process. In determining the extent of participation of students in different question items, percentage analysis was employed by the researcher. The technique enabled the identification of the major trends, preferences, and patterns concerning project-based learning in mathematics. Descriptive statistics involving frequency distributions, percentages, and comparisons were used in summarizing data from respondents in a clear way. Tables and graphs were also included to enhance the process of data analysis. The analysis process involved identifying the degree of interest of students, types of mathematics projects preferred by students, educational values gained from the projects, and challenges faced in conducting projects.

Results and Discussion

Student Interest in Mathematics Projects: The following table 2, which displays the degree of interest exhibited by the students towards mathematics projects according to their survey answers. From the findings, the majority showed a high level of interest where 42% were very interested while 38% were interested, thus demonstrating a positive attitude towards participating in projects related to mathematics. Those with neutral and no interest made up only 12% and 8% of the respondents, respectively in table 2 and figure 2.

Table 2. Level of student interest in mathematics

Response	Frequency	Percentage
Strongly Interested	42	42%
Interested	38	38%
Neutral	12	12%
Not Interested	8	8%

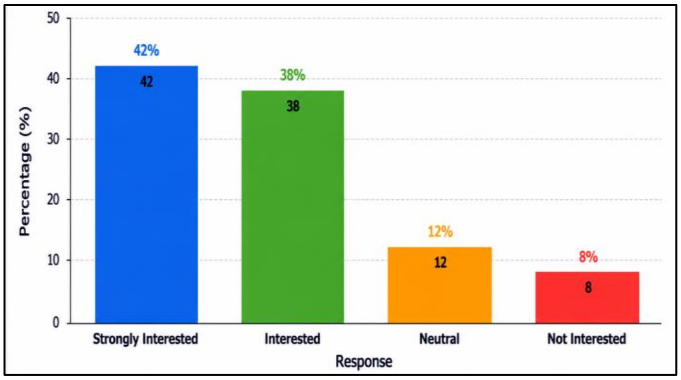

Figure 2. Interest Level Distribution

The results show that 80% of students expressed positive interest in project-based mathematics learning. This shows that most learners enjoy interactive and practical learning methods rather than traditional lecture-based instruction.

According to the study outcomes, project-oriented learning fosters a stimulating and learner-focused classroom atmosphere in teaching mathematics. Those who chose "Strongly Interested" and "Interested" indicated that mathematical projects aid them in comprehending complicated ideas with practical work, group interaction, and application to real-life experiences. Most learners felt that working with projects is less boring than listening to a lecture and promotes active participation in classes. The low number of students that did not obtain themselves interested could be associated with factors such as difficulties with calculations, time constraints, or insufficient ability to work within a team. In general, the data obtained illustrates the positive effect of projects on the motivation of students in math lessons.

Preferred Types of Mathematics Projects: The chart below indicates the distribution of students' choices regarding various types of projects within mathematics. Projects dealing with statistical surveys are chosen most often (30%), followed by financial projects (25%) and projects that include geometry designs (20%). There is great interest in the application of knowledge. The choice of data visualization projects and mathematical modeling projects is much less common (15% and 10% respectively) in table 3 and figure 3.

Table 3. Mathematics projects

Project Type	Percentage
Statistical Surveys	30%
Financial Mathematics Projects	25%
Geometry Design Projects	20%
Data Visualization Projects	15%
Mathematical Modeling	10%

The projects on statistical surveys were most favored because they required gathering and analysis of real-life data. Projects on financial mathematics were equally favored because they were found to be useful in everyday applications.

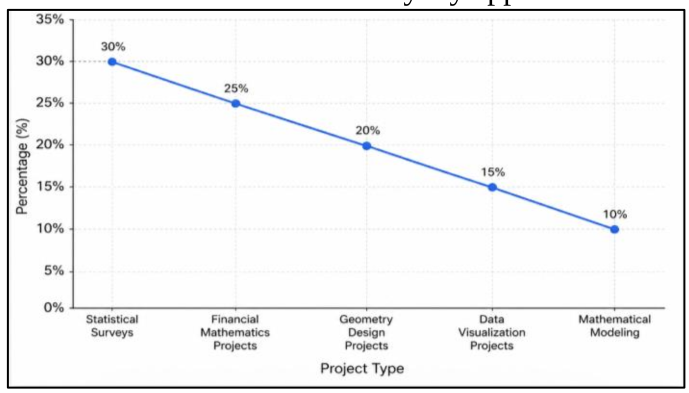

Figure 3. Project type percentage

The outcomes show that most learners prefer math projects that have practical significance. Statistic survey projects had the highest interest level from the students as they loved performing surveys, analyzing collected data, and using graph forms to display information. Students loved financial mathematics projects since these helped them learn how to budget, save money, and do various calculations that were applicable in real life. Those students who loved geometry design liked the idea of working on projects involving making geometrical designs and model making. With data visualization projects, the students could build their technology expertise through making table representations, graphs, etc. The lowest level of interest was perceived with mathematical modeling projects; however, some students showed appreciation for its advanced nature. In general, the findings show that most students like practical projects which have an element of creativity involved.

Benefits of Project-Based Learning in Mathematics: The following table demonstrates the benefits that have been observed by students regarding PBL in math class. The greatest number of students who comprised 35% cited enhanced understanding as the major benefit they perceived from the PBL experience. Secondly was improved teamwork among the participants (22%), while creativity followed closely behind at 18%. Other benefits included increased motivation (15%) and enhanced problem-solving skills (10%) in table 4 and figure 4.

Table 4. Benefits of project-based learning

Benefit	Percentage
Better Understanding	35%
Improved Teamwork	22%
Increased Creativity	18%
Higher Motivation	15%
Improved Problem Solving	10%

The findings suggest that PBL is highly effective at enhancing concept comprehension. Collaboration and creativity are other aspects that were favored by the students. The findings reveal that PBL offers several benefits to mathematics students.

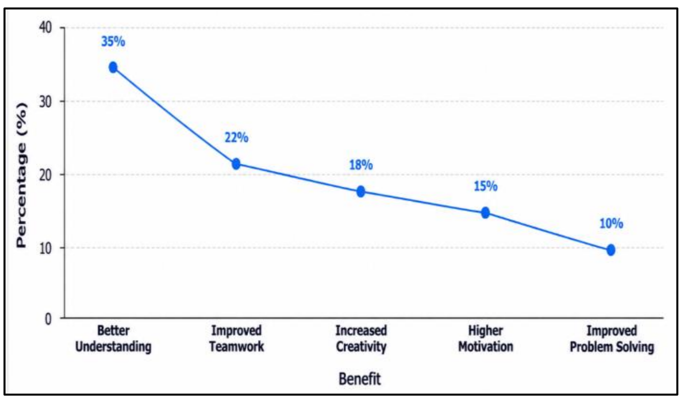

Figure 4. Perceived benefits

Many participants indicated that mathematical projects enhance the comprehension of complex ideas since the formulas and theories can be used in real-life situations rather than memorizing them. Good collaboration among students emerged to be another important advantage as group work fosters communication and cooperation among peers and helps to share new ideas. The ability to enhance creativity through such tasks as the development of presentations, models, data analysis, and problem-solving became another advantage highlighted by the participants.

Higher levels of motivation were recorded since the students enjoyed the process of performing project activities. Also, by doing projects, the students improved their analytical skills and problem-solving skills through thinking logically and independently. Based on these results, it can be stated that the performance of mathematical projects not only improves academic presentation but also promotes soft skill development.

Challenges Faced by Students: The following table depicts the problems encountered by students when engaged in project-based learning in mathematics. The most prevalent problem was time management at 34%, followed by hard calculations and group coordination problems at 26% and 20%, respectively. It indicates that there are problems in both personal and teamwork levels. On top of that, scarcity of materials and presentation fear comprised 12% and 8%, respectively in table 5 and figure 5.

Table 5. Challenges faced by students

Challenge	Percentage
Time Management	34%
Difficult Calculations	26%
Group Coordination	20%
Lack of Resources	12%
Presentation Anxiety	8%

While the students favored working on mathematical projects, there were certain problems faced. Lack of time and complexity in calculations were the major problems. The findings indicate that there are many challenges that the learners face when carrying out mathematics project exercises.

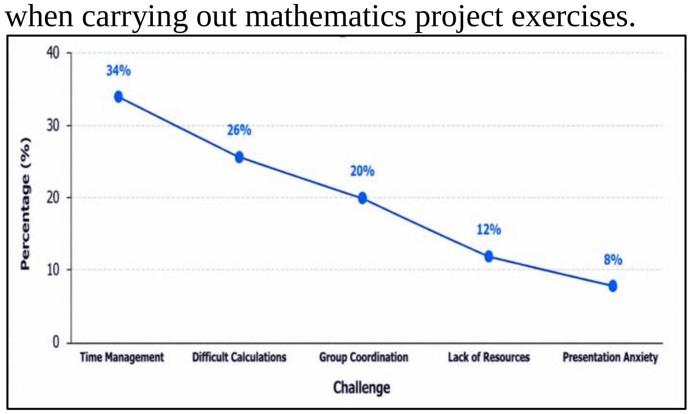

Figure 5. Challenges faced

Time management was the major issue because many students found it difficult to manage time between their class activities, examinations, individual tasks, and project assignments. Hard calculations were also a intense difficulty for many students because of their complex nature. Coordination was an important concern for many members because some members of the group did not have the same level of involvement in project tasks, while others faced communication problems with each other. Limited availability of educational materials, technological means, and books were other issues mentioned by many contributors because they could not find them in the library or anywhere else. Presentation fear was another problem for certain students since many students felt uncomfortable giving presentations of their results. Nevertheless, all the participants believed that project-based learning was helpful for them in developing important skills and knowledge.

Discussion: This study reveals that project-based learning is effective towards creating positive attitudes among students regarding their education in math. In addition, most respondents favored math projects due to their practical nature and engagement of students.

Moreover, the findings observed out that students were especially interested in survey projects, statistics, and financial mathematics projects since they link the subject with the real world. Collaboration learning was seen to improve communication skills among students.

Although some challenges were experienced like difficulty in calculating and managing time, most students felt that mathematical projects boost their confidence and competence in mathematics. This investigation is in line with previous studies on the topic.

Conclusion: In this paper, it analyzed how students viewed project-based learning in the perspective of learning mathematics courses. It has been examined that most students like project-based activities as this type of activity promotes comprehension, motivation, creativity, and applicability of mathematical concepts. Project-based learning helps the students to actively engage themselves in the method of learning rather than being passive observers. The statistical surveys, financial mathematics, and geometry design projects were among those activities which students liked more than others. Despite the problems such as managing time and solving complicated mathematical calculations, the benefits of such education are much more important compared to these obstacles. Conclusively, it is recommended that project-based learning be incorporated into the mathematics education process.

Acknowledgement: We sincerely appreciate the University of Information Technology, Yangon, Myanmar for providing the necessary resources for this research. We also express heartfelt gratitude to our families for their unwavering encouragement and support throughout this endeavor.

Conflicts of Interest: The authors announce that there are no funding sources or conflicts of interest related to this research paper.

Authors Funding: The authors have not received any funding related to this research or the publication of this paper.

Author Contribution: All authors were accountable for the study proposal, data interpretation, manuscript writing, data collection and analysis, and critical revision of the manuscript for important intellectual content. Both authors contributed equally, read, and approved the final manuscript.

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