Effectiveness of Problem-Based Learning Strategy in Improving Academic Performance of Grade 10 Students in Mathematics

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Abstract: Evidence of poor performance in mathematics by secondary school students highlights the fact that the most desired technological, scientific and business application for mathematics cannot be sustained. This makes it paramount to seek a strategy for teaching mathematics that aims at improving its understanding and performance by students practically. Problem-Based Learning as a method of teaching may be used to accomplish the instructional roles of learning basic facts, concepts, and procedures, as well as goals for problem-solving. Thus, the aim of the study reported here was to ascertain the extent to which the Problem-Based Learning (PBL) strategy would affect the achievement and retention of students when teaching Mathematics concepts as applied in the online learning in the Philippine secondary schools. The subject of this research was the twenty Grade 10 students of Calbeg National High School who were diagnosed to have difficulty in solving probability problems during the third quarterly examination of this School Year 2019-2020. All the needed data for the study were drawn from the questionnaires taken from the Learner’s Material of Grade 10 and other reference books in Mathematics. Frequency and t-test were used to treat the academic performance of the Grade 10 students in the pretest and posttest.

1. Introduction

The development of students' Mathematics understanding is generally accepted to be one of the major goals of K-12 mathematics teaching. Mathematics is a branch of mathematics in which symbols (usually letters) represent unknown numbers in mathematical equations [10]. Over the years, there have been students who have not performed well on math testing as they have in the classroom. Students' experiences with Mathematics begin with the acquisition of knowledge about procedures or operations that are used in dealing with Mathematics situations. Topics in Mathematics are taught for its usefulness in other branches of mathematics, and in the generalization of scientific truth, its power and verification of results more simply and satisfactorily; and its practical value in trades and industries [1]. Mathematics provides a conceptual foundation for the understanding of other concepts that students encounter in the school mathematics curriculum. The importance of this area of mathematics has been underlined by the increasing attention the teaching and learning of Mathematics have received over the past decade from teachers and researchers alike. Children's understanding of Mathematics concepts begins in the early years of their school life and continues throughout their mathematics learning experiences in high school and beyond. Mathematics also provides an effective way of expressing complicated relations and as a good instrument for mental training. Mathematics was chosen because it inculcates the power of analysis and provides a good instrument for mental learning [1].

The ubiquity of the subject matter of Mathematics in the K-12 mathematics curriculum further attests to its critical role in helping students develop an appreciation...
of links that exist among other topics in mathematics. Indeed, this issue has been given considerable attention to the agenda of major curricular documents [5].

The present-day teaching and learning of mathematics are far from being satisfactory. [8] observed that mathematics is one of the most poorly taught, widely hated and poorly understood subjects in our schools. [6] had blamed this on several factors, which range from the students’ perception that mathematics is difficult, shortage of qualified mathematics teachers and lack of mathematics laboratory. The persistent poor performance of secondary school students in mathematics examinations both in teacher-made tests and external examination is now a global issue. The students’ low performance in mathematics is an indication of low mastery of the subject. This poor result calls for serious concern and this has made researchers in mathematics education to consider several factors. One of the factors, as examined in this study, is the appropriate method of teaching.

[2] noted that very little work has been done on how achievement in mathematics can be improved by focusing attention on the students from which efforts at improvement should emanate. Others, according to Ali have suggested the improvement of the cognitive demand levels of the secondary school curriculum in mathematics. Many non-professional and in-experienced teachers present topics in mathematics to the student in such ways that the students find it difficult to grasp some mathematics concepts [3]. According to [4] many teachers cling to traditional methods in which answers to the previous day’s home works are first given, then the teacher-directed explanations are used to present materials for the new lesson. The powers of thinking and understanding are thus not developed in the students. One of the many strategies that have the potentials to put students at the center of their learning is through Problem-Based Teaching. Today, it is recognized that every person must be empowered to suggest possible explanations, to propose ways to test personal or class, to collect and interpret data obtained, to communicate the process and results to others.

The use of Problem-Based Learning in the mathematics classroom with the aid of technology may enhance the quality of mathematics teaching and learn in the Philippines. Problem-Based Learning as a method of teaching may be used to accomplish the instructional roles of learning basic facts, concepts, and procedures, as well as goals for problem-solving. The purpose of this study is to shed light on this issue. Thus, the aim of the study reported here was to ascertain the extent to which the Problem-Based Learning (PBL) strategy and the use of technology to employ it would affect the achievement and retention of students when teaching Mathematics concepts in the Philippine secondary schools.

2. Conceptual Framework

With Problem-Based Learning (PBL), learning begins with a problem to solve, and the problem is posed in such a way that the students need to gain new knowledge before they can solve the problem [12]. PBL as an instructional strategy based on constructivism is the concept that students construct their understanding by relating the concrete experience to existing knowledge where the process of collaboration and reflection are involved. PBL is generally based on ideas that originated earlier and nurtured by different researchers like Dewey, Bruner, Piaget, Ausubel, Novak, and Hanesian [9].

In Problem-Based Teaching, the teacher acts just as facilitator, rather than a primary source of information or dispenser of knowledge. [12] argued that within Problem-Based Learning environments, teachers’ instructional abilities are more critical than in the traditional teacher-centered classrooms. Beyond presenting mathematical knowledge through the use of a PowerPoint presentation to the students,
teachers in Problem-Based Learning environments must engage students in marshaling information and using their knowledge in applied and real settings.

In the Problem-Based Learning model, the students turn from passive listeners of information receivers to active, free self-learner and problem solvers. It also shifts the emphasis of educational programs from teaching to learning. It enables the students to learn new knowledge by facing the problems to be solved instead of feeling boredom. Problem-Based Learning affects positively certain other attributes such as problem-solving, information acquisition, and information sharing with others, group works, and communication, etc. Again problem-solving is a deliberate and serious act, involves the use of some novel method, and with the aid of technology, higher thinking and systematic planned steps for the acquisition set goals. The basic and foremost aim of this learning model is the acquisition of such information based on [7].

The teacher-researcher used the Independent–Dependent variable. The independent variable was the use of Problem-Based Learning. The dependent variable was the performance of the Grade 10 students in Mathematics.

![Figure 1.1 The Paradigm of Study](image)

**Figure 1.1 The Paradigm of Study**

**INPUT**

Results of the Pretest and Posttest of Grade 10 Students in Mathematics

**PROCESS**

Problem-based Learning Evaluation

**OUTPUT**

Improved Academic Performance of Grade 10 Students in Mathematics through Problem-based Learning.
3. Statement of the Problem
This study focused on the improvement of students’ academic performance in Mathematics using problem-based learning to Grade 10 students of Calbeg National High School, Municipality of Malasiqui, Schools Division Office of Pangasinan I, during the School Year 2019-2020.

Specifically, this study aimed to answer the following research questions:
1. What is the academic performance of the Grade 10 students in the pretest and posttest?
2. Is there a significant difference between the academic performance of the Grade 10 students in the pretest and posttest?

4. Hypothesis
There is no significant difference between the levels of performance of the Grade 10 students in the pretest and posttest.

5. Scope and Delimitation
The respondents of this study handled by the teacher-researcher were the Grade 10 students which consists of twenty students out of the eighty-one students. The respondents were identified having a difficulty in Mathematics as identified during their third quarterly examination. It is a heterogeneous group of students composed of five male students and fifteen female students.

6. Research Design
The teacher-researcher used the experimental research design. An experimental research design was employed to improve the Grade 10 students’ academic performance in Mathematics using problem-based teaching applied in technology. The teacher presented the lesson thru powerpoint presentation and video lesson and the students will access using their gadgets. The teacher-researcher used one group pretest-posttest design in his study. Pretest and posttest questions were drawn on the topic during the third quarter. It focuses mostly in solving probability.

The researcher used the experimental method of research since it is the only method of research that can truly test hypothesis concerning cause-and-effect relationships. It represents the most valid approach to the solution of educational problems, both practical and theoretical.

Also, according to [7] when properly applied, the experimental research design is the best type for testing hypotheses about cause and effect relationships. It contends the experimental research determines the impact of an intervention on an outcome for participants in a study.

According to [10] the experimental research design is a controlled procedure that sees the manipulation of an independent variable (IV) to observe or measure its effect on a dependent variable. It contends the experimental research determines the impact of the intervention on an outcome for participants in a study. Experimental design allows one to make causal inferences about relationships among variables.

7. Sources of Data
The study was conducted in Calbeg National High School, Municipality of Malasiqui, Schools Division Office of Pangasinan I. The research had spanned from March to May. The respondents of this study handled by the teacher-researcher were the Grade 10 students which consists of twenty students out of the eighty-one students. The respondents were identified having a difficulty in Mathematics. It is a heterogeneous group of students composed of five
male students and fifteen female students. These students were selected based on their scores on the said examination.

8. Instrumentation and Data Collection

The teacher-researcher asked permission to conduct the study from the office of the School Principal. The intervention used is Problem-Based Learning which was employed using technology platform like video lesson and PowerPoint Presentation after the conduct of pretest followed by a posttest. Pretest and Posttest was sent to the students thru the created group chats.

9. Tools for Data Analysis

Responses of the respondents were tallied, tabulated and analyzed both descriptively and inferentially, to answer the problems raised in this study;

Problem 1 dealt with the extent of the performance of Grade 10 students before and after the use of Problem-Based Learning in-class activities and performance presented in the PowerPoint. This was treated using frequency and percentages.

Problem 2 dealt with the significant difference between the extent of performance of Grade 10 students in their Mathematics class activities and lessons before and after the use of Problem-Based Learning. This was treated using a t-test.

10. Results and Discussions

Table 3.1 presents the academic performance of the Grade 10 students in the pretest and posttest. The table discloses that the performance of the Grade 10 students has a mean of 13.1 in the pretest and 17.75 in the posttest.

<table>
<thead>
<tr>
<th>Students</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>25</td>
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<tr>
<td>3</td>
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<td>20</td>
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</tbody>
</table>

The students’ low performance in Mathematics is an indication of low mastery of the subject. This poor result calls for serious concern and this has made researchers in mathematics education to consider several factors. One of the factors, as examined in this study, is that of the appropriate method of teaching.
This suggests that the Problem-Based Learning (PBL) students have developed competence in essential skills of numeracy and a deeper understanding of the content knowledge of learned materials compared to when no intervention is being employed yet.

**Significant Difference between the Academic Performances of Grade 10 Students in the Pretest and Posttest**

Table 3.2 presents the significant difference between the academic performance of the Grade 10 students in the pretest and posttest.

Table 3.2. Significant Difference Between the Academic Performance of the Grade 10 students in the Pretest and Posttest

<table>
<thead>
<tr>
<th>Academic performance</th>
<th>N</th>
<th>Mean</th>
<th>t</th>
<th>t-crit at 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>20</td>
<td>13.1</td>
<td>-6.94</td>
<td>-1.729</td>
</tr>
<tr>
<td>Posttest</td>
<td>20</td>
<td>17.75</td>
<td></td>
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</tbody>
</table>

The most important achievement of a teacher is to help his/her students along the road to independent learning and the aid of technology. Presenting the students with a problem, allow them to take risks, to adopt new understandings, to apply knowledge, to work in context and to enjoy the thrill of being discoverers. [11] In those classrooms in which the Problem-Based Learning strategy is used for the instructional process, the students take much more responsibility for their learning. They have become independent and long-life students and can continue to learn in their whole life.

It appears from Table 2 that the t-computed value of -6.94 is beyond the t-critical value of -1.729 at 0.05 level of significance with 19 degrees of freedom (df), The hypothesis which states that there is no significant difference between the academic performance of the Grade 10 Students in the Pretest and Posttest is therefore rejected.

This means that students taught with problem-based learning have achieved better as compared when there is no intervention yet. Students made significant progress in learning outcomes by being stimulated with realistic questions. They gradually became more involved in the instruction and feel the learning was easy and fun. The findings revealed the efficacy of the use of PBL (Problem-Based Learning) in enhancing students’ achievement in Mathematics. Thus, students in groups can find ways to develop real-life problem-solving capabilities and develop the competencies to become self-guided students.

The findings corroborate that of [8] from Pakistan, [10]) from South Africa as well as [11] in Nigeria, who all attested that students’ learning outcomes were observed to be better than those with ordinary learning approaches.

**11. Conclusions**

Based on the findings the following conclusions were drawn:

1. At the implementation of Problem-Based Learning (PBL), the instructional activities became more interesting to students. The learning method changed from static to dynamic. It is evident from the findings of this study that the use of a Problem-Based Learning strategy could provide a good way for students to learn Mathematics.
2. In the process of PBL, students were found to obtain key knowledge, skills, and competences by cooperating with others to collect information, share opinions, and select problem-solving plans.
3. Problem-Based Learning enhances students’ academic performance in Mathematics. A student who is exposed to this type of strategy is more likely to possess a meaningful
in-depth knowledge of the content area. Students were able to organize their thoughts in an orderly manner that is essential for problem-solving and the acquisition of basic practical skills in mathematics.

4. PBL should, therefore, be used as an additional teaching strategy to other traditional methods of teaching mathematics. This could help in improving students’ performance in the subject.

5. Another remarkable finding related to the retention period is that students in PBL remember more of the acquired knowledge.

12. Recommendations

Based on the conclusions, the following recommendations are

1. If this method, proposed by this study, is adopted in Mathematics teaching and learning, it will boost the performance of students in skills acquisition, problem-solving ability, and development of the right type of attitude toward mathematics as a subject.

2. Mathematics teacher trainees should be trained on the use of a Problem-Based Learning strategy with the aid of technology;

3. Teachers of mathematics should use Problem-Based learning to improve the academic achievements of the students, and seminars and workshops should be organized for Mathematics teachers in elementary and secondary schools to employ Problem-Based Learning in the classrooms.

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References


