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Effectiveness of Problem-Based Learning to the Performance of Grade 8 Students in Science: Basis for Instructional Supervision

JEMALYN D. GALO
Teacher III
Western Leyte College
Master of Arts in Education
Major in School Administration and Supervision
jemalyn.dosdos@deped.gov.ph

ABSTRACT

Contemporary developments in science and technology have necessitated changing in instructional strategies and approaches in teaching and learning science especially in the secondary schools for developing learners' skills that would make them competitive in the 21st century world. Students must possess the needed skills to combat life's difficulties and challenges. With these advancements in the science curriculum, teachers and school administrators are motivated and triggered to formulate intervention programs to address the needs of the students today. Hence, this study was formulated to evaluate the effectiveness of problem-based learning in improving the performance of Grade 8 students in science. From the result of the study, the researcher developed an instructional supervision plan to be utilized by the school administrators and mentors in conducting monitoring and provision of technical assistance for the improvement of the intervention activities. A researcher-made science test which covers the 2nd quarter learning competencies was used to measure the performance of the students before and after the integration of problem-based learning in science. Simple percentage and t-test of mean difference were the statistical tools used to interpret the result of the study. The study revealed a significant difference in the performances of Grade 8 students in science before and after the integration of problem-based learning. This implies effectiveness of the intervention provided to the students. The integration of problem-based learning in teaching science encourages students to take an active role in their learning. By working on authentic problems, conducting experimental activities, and providing relevant and interactive activities to the students in finding solutions to the problems presented, students become more self-directed and independent learners. Further, it turned out that students learn to discuss among themselves their activities, they freely share their ideas about a phenomenon and other experiences, collaborate with their team members in solving complex problems and most importantly, they were able to apply the concepts in science in their day-to-day activities which helps deepen their understanding and able to construct meaningful knowledge. Hence, from this study, it is evident that integrating problem-based learning in teaching science concepts is an effective approach in improving the performance of the students for the subject. It is recommended that school heads and mentors must craft assessment tool to measure the level of learning of the students while utilizing problem-based learning in science.

Keywords — Effectiveness, Problem-Based Learning, Performance, Grade 8 Students, Science, Instructional Supervision

I. INTRODUCTION

Preparing students for real-life challenges is one of the most important goals in education. Students are taught in school not only to know the basic knowledge or pre-requisite skills for the future degree they will be taken up in college

but also on how they will be able to solve and face problems and challenges they met along the way. Students nowadays must be resilient and smart enough to provide appropriate solutions to every problem they encounter in school or in their day-to-day activity. That is why problem-based learning activities are encouraged in every teaching-learning process.

Problem-based learning is a teaching method in which complex real-world problems are used as vehicle to promote student learning of concepts and principles as opposed to direct presentation of facts and concepts in teaching a particular subject. In addition, problem-based learning can promote the development of critical thinking skills, problem-solving abilities, and communication skills. It also provides opportunities for working in groups, finding, and evaluating research, and life-long learning where they will use as they continue with their quest for knowledge.

One of the strategies used by teachers in teaching science is the problem-based learning approach. It is observed during the teaching-learning process that students have limited knowledge in the conduct of experimentation or any research endeavor. As it is transparent in the result of the 1st quarterly assessment that most of the grade 8 students have difficulty in solving problem related questions. The fact that these students were used in explicit way of teaching the concepts.

Teaching and learning science concepts and competencies have evolved over time. The rampant sole improvement of essential skills, the 3Rs – Reading, ‘Riting and ‘Rithmetic, is, at present, insufficient to cope with the fast-changing world. The new era of education requires the sharpening of the 21st century skills, the 7C’s, to wit: Critical thinking and problem solving; Creativity and innovation; Collaboration, teamwork, and leadership; Cross-cultural understanding; Communications, information, and media literacy; Computing and ICT literacy; and Career and learning self-reliance (Trilling & Fadel, 2009). These sets of skills help prepare students to grow with confidence, to succeed in this rapid transition, and to compete globally in the future. Hence, educators are encouraged to utilize one of the approaches in constructivism; that is, Problem-Based Learning (PBL).

PBL begins with the presentation of an ill-structured problem to be solved that has potentially multiple solutions. Teachers act as facilitators throughout the strategy, guiding learners with meta-cognitive questions, and learners actively construct knowledge by defining learning goals, seeking information to build upon prior knowledge, reflecting on the training process, and participating in active group collaboration.

PBL is recognized as an inquiry approach because it prompts student’s curiosity to solve problems, but also since questioning and research are at the core of the development of the process of learning. Furthermore, an inquiry approach also relates to activities in which students develop knowledge and the understanding of scientific ideas, as well as catch on how scientists study the natural world.

The Constitution of the Philippines encourages all educational institutions to promote critical and creative thinking among the Filipinos. The Bureau of Secondary Education endorses the following objectives in science to make it possible by: (1) promoting student awareness of the relevance of science to life, and (2) developing critical and creative thinking skills as well as skills in problem solving (Bureau of Secondary Education, 2009). Many education systems are characterized by learning through memorization, imitation learning, and modelling learning (Hamidi *et al.*, 2011; Helikar *et al*., 2015). These systems are important for the acquisition of basic knowledge and skills. However, these are not enough for students to develop the necessary thinking skills to deal with real-world problems. The world needs students who can think critically, possess good communication skills, able to reason out on how he/she come up with the correct solutions and those who can scientifically prove hypothesis through research.

Thus, it is in this premise that the researcher decided to conduct this study to evaluate the effectiveness of problem-based learning in the performance of grade 8 students in science. A proposed instructional supervision plan was formulated based on the findings of the study.

It is in the rationale that the researcher who is currently a grade 8 Science teacher in the above mentioned local, would like to delve worthy research undertaking that would benefit herself, the school she is currently teaching and that of her Graduate Program she is enrolled at.

This study evaluates the effectiveness of problem-based learning in the performance of grade 8 students in science in Seguinon National High School, Albuera North District, Leyte Division for School Year 2023-2024. The findings of the study were the basis for the proposed instructional supervision plan.

Specifically, this study sought to answer the following questions:

1. What is the performance of the Grade 8 students before the integration of problem-based learning in teaching?

2. What is the performance of the Grade 8 students after the integration of problem-based learning in teaching?

3. Is there a significant difference in the performance of the Grade 8 students before and after the integration of problem-based learning in teaching?

4. What instructional supervision plan can be proposed based on the findings of this study?

II. METHODOLOGY

Design. This study employed the quasi-experimental research design utilizing the pre-test and post-test to evaluate the effectiveness of problem-based learning in the performance of grade 8 students in science for School Year 2023-2024. Seguinon National High School, Albuera North District, Leyte Division is the main locale of the study. The 37 Grade 8 students enrolled in the said locale are the main respondents of the study. This study utilized the validated, researcher-made Science test in Grade 8. The competencies in the 2nd quarter Most Essential Learning Competencies (MELCs) were the basis in the formulation of the test. This is a 30-item test questions which best describe activities on problem-based learning. The test was conducted before and after the integration of the intervention in teaching science lessons. Moreover, the researcher prepared lesson plans for teaching Science based on the competencies for the second quarter through giving of experimental activities which will develop their critical thinking skills, problem-solving, scientific reasoning and knowledge, decision-making, assessment, and evaluation, and as part of the intervention for this study. The researcher formulated differentiated activities and questions where students must conduct research. Utilizing the background knowledge in problem-solving and scientific study with equipment and apparatuses ready for utilization by the students during experiments, it is expected that performance of the students in science will improve. The materials crafted and other activities formulated were submitted to the District Coordinator and Quality Assurance Team for evaluation, validation, and adjustments before it was utilized by the students in the classroom. A matrix of activities was crafted to guide the teacher-researcher the flow of her study. This research focused on evaluating the effectiveness of problem-based learning in the performance of grade 8 students in science through the pre-test and post-test and its significant difference. A Proposed Instructional Supervision Plan based on the findings of the study is the output.

Sampling. There are 37 Grade 8 students involved in this study. They are the students enrolled in the grade for School Year 2023-2024 in the said locale. Complete enumerations were used to identify the respondents of the study. A researcher-made test in science was used as a tool and the implementation of the intervention was administered personally to each of the students during the assessment period following the prescribed health protocol.

Research Procedure. The researcher prepared the research design and tools utilized in the study. Approval and recommendation from the Panel of Examiner of the Graduate Studies was sought. A letter request to conduct this study was forwarded to the Office of the Schools Division Superintendent. Upon approval, permission from the District Supervisor and School Head was secured before the actual gathering of data. Orientation of the participants and administration of the pre-test was done face-to-face after the approval of the permit from the parents of the respondents. Data privacy was emphasized also in the meeting. After accomplishing the pre-test, intervention was given within four weeks. Grade 8 students were provided with activities where they must conduct experiments or research and questions will be posted by the teachers where students must formulate answers through observation and experimenting. The teacher facilitates the students in formulating answers to the activities while learning materials and other resources were provided by the teacher and this formed part of the intervention for the study. After the intervention, a post-test was provided. Answers were checked, collected, tabulated, and submitted for statistical treatment. Analysis and Interpretation of Data. Making of Proposed Instructional Supervision Plan followed. A Matrix of Activities was prepared by the researcher to track the progress of gathering the data.

Ethical Issues. The researcher properly secured the permission to conduct the study from the authorities through written communication. In the formulation of the intervention materials that was used in the study, the use of offensive, discriminatory, or other unacceptable language was avoided. The respondents' names and other personal data were not included in this study to protect their privacy. Participation of the respondents was also voluntary. Orientation was conducted for the respondents with their parents. In the orientation, issues and concerns were addressed and consent to be included in the study were signed. The researcher-maintained objectivity in analyzing and discussing the results. All authors whose works were mentioned in this study were properly quoted and were acknowledged in the reference.

Treatment of Data. Simple Percentage was employed to evaluate the performance of the grade 8 students in science before and after the integration of problem-based learning in teaching the subject. **t-Test of Mean Difference** was used to determine the significant difference in the performances of the grade 8 students in science before and after the integration of problem-based learning in teaching the subject.

III. RESULTS AND DISCUSSION

TABLE 1

PERFORMANCE OF GRADE 8 STUDENTS IN SCIENCE BEFORE THE INTERVENTION

Score Range	Description	PRETEST	
		Frequency	%
25-30	Excellent	0	0
19-24	Very Good	0	0
13-18	Good	13	35
7-12	Fair	18	49
1-6	Poor	6	16
Total		37	100
Weighted Mean		**10.46**	**Fair**

Table 1 presents the performance of Grade 8 students before the integration of problem-based learning in teaching in science. It was shown on the table that among the 37 Grade 8 students, 6 or 16% got a score of 1-6 which is interpreted as poor. This means that these students achieve a lower level of understanding of scientific concepts. They used traditional methods such as rote memorization or didactic instruction that is why students' lower order thinking skills were developed. This implies assistance from the teacher that will guide the students in achieving success in learning science concepts through the integration of experimental activities to arrive at a conclusion. They need to learn to conduct experiments of their own with the guidance of the teacher. In this group of students, teachers must create a classroom environment where students must engage in activities and be able to find solutions to the problems posted in the activities. Science process skills are the thinking skills that are used by scientists during the construction of knowledge toward solving problems (Mutlu & Temiz, 2013; Ozgelen, 2012). The integration of problem-based learning is suited to be utilized in doing the experiments. Problem-based learning is an approach where students learn by actively engaging in real-world, open-ended problems where their critical thinking is needed to arrive at a conclusion or answers to the problem posted. It is a creative approach of combining creative and best approaches to instruction, as an attempt to build on learner curiosity.

Moreover, 18 or 49% got a score of 7-12 which is interpreted as fair. This means that students achieve an average or moderate level of understanding or proficiency in learning scientific concepts. This implies that the students' learning approach is in traditional way where the teacher gives them the concepts of the lesson without doing significant activities or showing to the students the solutions to every problem in science. In this group of students, the need to create interactive activities where finding solutions to problems can be achieved through the conduct of experimentation.

Further, only 13 or 35% got a score of 13-18 which is interpreted as good. This means that these students achieve a good level of understanding and proficiency in learning scientific concepts. Hence, it is implied that although they achieve good performance still, they need intervention activities to improve their level of learning in science. Involving students in problem-based learning can be meaningful and achievable because their critical thinking will be developed.

Finally, the performance of the Grade 8 students before the integration of problem-based learning in teaching in science got an average mean of 10.46 which is interpreted as fair. This means that the Grade 8 students had achieved a fair level of understanding scientific concepts, thus, a need for intervention activities which will involve the students in solving science-related problems. This implies additional learning support materials and activities which will develop

their understanding and applying such knowledge in making connections with previous learning to arrive at a concrete solution to problems. Integrating problem-based learning in teaching science is needed by the students to achieve educational goals and attain the desired learning outcomes for the subject. The use of problem-based learning in science education mirrors positive effects in improving students' achievements and critical thinking skills (Argaw et al., 2016; Awan et al., 2017; Lisniandila et al., 2018).

TABLE 2

PERFORMANCE OF GRADE 8 STUDENTS IN SCIENCE AFTER THE INTERVENTION

Score Range	Description	POST TEST	
		Frequency	%
25-30	Excellent	13	35
19-24	Very Good	15	41
13-18	Good	9	24
7-12	Fair	0	0
1-6	Poor	0	0
Total		37	100
Weighted Mean		**22.14**	**Very Good**

Table 2 presents the performance of the Grade 8 students in science after the integration of problem-based learning. It was revealed on the table that among the 37 Grade 8 students, 9 or 24% got a score of good while 15 or 41% got a score of 19-24 which is very good and 13 or 35% got a score of 25-30 which is excellent. Further, it was shown on the table that the performance of the Grade 8 students after the integration of problem-based learning in teaching science, the students achieved a weighted mean of 22.14 which is at the level of very good. The result of the assessment shows that there is an increase in the performance of the students after the integration of problem-based learning. In this activity, the daily lesson of the teacher in science has an integration of activities where students must take part in looking for the solutions of the problem posted. They conducted experiments for which the teacher serves as facilitators. The students show mastery of the scientific concepts for they were able to think creatively, solve complex problems, and effectively communicate their findings and results. The integration of problem-based learning had provided them with the knowledge and skills in relating scientific understanding to the hands-on activities they are doing. Students here are more dedicated and motivated to do the tasks given them for they are the once doing the experiments with the guidance and assistance of the teachers. The experiences of the students in doing the hands-on activity, and being responsible in finding solutions to the problems, exploring, and discovering content materials and reflecting upon learning processes to have a deeper understanding of scientific concepts had helped them in achieving excellent performance. The result of the study implies effectiveness of the intervention provided to them and motivation to achieve the desired learning outcomes. Problem-based learning may improve students' achievement and hone their 21st century skills as it reflects modern insights to learning (Dolmans et al., 2005). It has been implemented for almost five decades now and remains one of the most innovative constructivist pedagogical approaches used worldwide. It prepares students for the real-life challenges that they may encounter in the future (Moallem et al., 2019). These real-life problems activate students' prior knowledge, elaborate initial discussion, and eventually elicit their interest in the situation. Thus, the use of PBL helps teachers to unveil students' previous knowledge through stimulating problems. As they seek and organize relevant information, they close their own knowledge gaps that lead to understanding and learning new concepts (Rotgans & Schmidt, 2014), making them more self-reliant and responsible for their own learning (Moallem et al., 2019).

TABLE 3

TEST OF DIFFERENCE IN THE PERFORMANCE OF GRADE 8 STUDENTS BEFORE AND AFTER THE INTERVENTION

Aspects	Test Scores		Computed T	Critical T	Decision	Interpretation
Grade 8 Students in Science	Pre Post	10.46 22.14	1.346	0.671	Reject H_o	Significant

Table 3 presents the test of difference in the performances of Grade 8 students in science before and after the integration of problem-based learning. It was revealed on the table that the pre-test of 10.46 had increased to 22.14 after the integration of problem-based learning which resulted in 1.346 computed value of t. This result shows that the computed t of 1.346 is greater than the critical value of t of 0.671 at 0.05 level of significance, so null hypothesis is rejected. This means that there is a significant difference in the performances of Grade 8 students in science before and after the integration of problem-based learning. This implies effectiveness of the intervention provided to the students. The integration of problem-based learning in teaching science encourages students to take an active role in their learning. By working on authentic problems, conducting experimental activities, and providing relevant and interactive activities to the students in finding solutions to the problems presented, students become more self-directed and independent learners. Further, it turned out that students learn to discuss among themselves their activities, they freely share their ideas about a phenomenon and other experiences, collaborate with their team members in solving complex problems and most importantly, they were able to apply the concepts in science in their day-to-day activities which helps deepen their understanding and able to construct meaningful knowledge. Hence, from this study, it is evident that integrating problem-based learning in teaching science concepts is an effective approach in improving the performance of the students for the subject.

Studies that have compared problem-based learning with traditional approaches to teaching offer factual insights into the relative value of the problem-based learning approach as a means of reaching student mastery of curricular content (Hidayat et al., 2020; Zhao et al., 2020). These comparative studies revealed that PBL is an effective means of teaching content knowledge. For instance, the use of problem-based learning had a positive impact on learning the mixtures topic in a Chemistry classroom as compared to the traditional approaches (Üce & Ateş, 2016). The studies by Tawfik et al. (2020) and Iswari et al. (2018) showed that the use of problem-based learning as one of the inquiry-based learning approaches outperformed the traditional teaching methods and case-based learning in conceptual understanding. Despite its significance, PBL has been criticized for providing minimal guidance leading to a cognitive burden for learners (Kirschner et al., 2006).

IV. CONCLUSIONS

The study revealed a significant difference in the performances of Grade 8 students in science before and after the integration of problem-based learning. This implies effectiveness of the intervention provided to the students. The integration of problem-based learning in teaching science encourages students to take an active role in their learning. By working on authentic problems, conducting experimental activities, and providing relevant and interactive activities to the students in finding solutions to the problems presented, students become more self-directed and independent learners. Further, it turned out that students learn to discuss among themselves their activities, they freely share their ideas about a phenomenon and other experiences, collaborate with their team members in solving complex problems and most

importantly, they were able to apply the concepts in science in their day-to-day activities which helps deepen their understanding and able to construct meaningful knowledge. Hence, from this study, it is evident that integrating problem-based learning in teaching science concepts is an effective approach in improving the performance of the students for the subject.

V. RECOMMENDATIONS

1. Utilize the proposed instructional supervision plan formulated.

2. Teachers must utilize the intervention formulated to improve the performance of the students in science.

3. School administrators must formulate training design to conduct training on the proper utilization and formulation of problem-based learning activities which will be used by them in teaching science.

4. Teachers should implement, employ, and incorporate problem-based learning into the classroom for the students to construct and develop their own understandings of knowledge and actively learn and interact with curriculum content.

5. Teachers and school heads should be equipped and prepared for the classroom environment to promote effective problem-based learning for meaningful and deeper instruction and learning through the readiness and mastery of the teacher in utilizing the said approach in teaching science.

6. Teachers must conduct research and understand the necessary components, materials and planning time needed to implement problem-based learning to present effective learning among lessons in science.

7. Administrators and science advocates should be morally encouraged to introduce problem-based learning approach into science classroom to promote deeper and active learning and engagement of students to all science activities, and

8. Future researchers should replicate this study to include different locales and include different variables aside from the mentioned in this study.

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