

The Use of Modular Distance Learning in Relation to the Problem-Solving Skills in Statistics and Probability of Grade 11 Students

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Abstract

This study determined the use of modular distance learning (MDL) in relation to the problem-solving skills in statistics and probability of Grade 11 students in Bula National High School, the School year 2021-2022. It drew out the profile of the Grade 11 learners' pre-test scores of the problem-solving skills in Statistics and probability utilizing modular distance learning in terms of Analysis, Estimation and Approximation, Hypothesis Testing, and Applied math; the profile of the learners' post-test scores after their exposure to the modular distance learning; tested the significant change in the improvement brought by the utilization of MDL, and the uses of findings to apply in the lesson content and subject matter in Statistics and Probability. The study used the descriptive-evaluative correlational method to determine the data needed under the present investigation. Purposive and quota sampling was used. The research Subjects were the (30) Grade 11 learners of Bula National High School. Weighted Mean, frequency count, percentage, mean and MPL, and t-test were used to treat the data statistically. The significance level was set at 0.05. It revealed that the profile of the learners' post-test scores after their exposure to modular distance learning is satisfactory and significant improvement existed, implying that the utilization of modular distance learning in statistics and probability is effective.

Keywords: Modular Distance Learning; Grade 11 Students; Problem Solving Skills; Statistics Probability; Bula National HS

1. Introduction

Education is one of the most significant factors in producing vital human resources in nation-building. It gives light on developing the cognitive skills and attitudes of any individual. Also, it is composed of various disciplines, which should be taught and learned by everyone. One of the most established disciplines and is part of every curriculum around the world is mathematics. For educators, the top priority is the quality of students' performance to academic standards. Students' attitudes towards mathematics education can significantly impact their engagement with math learning and their subsequent learning and achievement of the expectations. All students must take responsibility for their learning as they progress through elementary and secondary school. Understanding the skills and concepts connected with learning in the mathematics curriculum requires a commitment to learning.

Students engage in their learning and have opportunities to solve interesting and applicable. Meaningful problems within a helpful, safe, and inclusive learning environment are likelier to adopt practices and behaviors that support mathematical thinking. More importantly, they are more likely to enjoy mathematics and pursue their desire to learn maths beyond the classroom.

Face-to-face learning engagement of students and teachers within the school has been deferred due to the COVID-19 pandemic. This pandemic has given way to the implementation Modular Distance Learning as an urgent response to ensure continuity of education without compromising the health of everyone. The Philippines is in the process of adapting to the new normal form of education at present, and continuous innovations of educators and active involvement of other stakeholders are the driving force for its success. The fundamental purpose of this research is to find out the challenges encountered, opinions, and recommendations of teachers, parents, and students in implementing Modular Distance Learning in the Philippines. The reiteration of the asynchronous and synchronous educational approach has been widely used for modular distance learning to ensure the quality of education. (Sumaoang 2020). According to Alcantara (2015), education is vital in everyone's life; therefore, studying mathematics is significant in man's everyday life. To assist students in grasping the lessons, teachers who support learning should plan and utilize many tactics and approaches. She said that creating a learning module is a significant amount of work a teacher would put in to help pupils learn. With this, Alcantara (2015) also stated that modules are the most frequently accepted learning resources. Thus, it is critical to plan ahead of time. It influences learning because the usage of this material has already spread around the world, and its use affects the learning process of students worldwide, particularly in the field of mathematics. Marcelo (2021) states that as part of effective teaching practice, teachers communicate with parents, using multiple ways and both formal and informal means to meet the diverse needs of families and better understand students' mathematical experiences outside of the school. In addition, teachers discuss with parents what their children are learning in mathematics at school. Communication enables parents to work in partnership with the school, leading to stronger connections between the home and school to support student learning and achievement in mathematics (Marcelo 2021).

In Mathematics, the students' perspectives agreed on employing a modular distant learning technique. They agreed on several advantages of this method (Dangle, 2020). The students acknowledged that using a modular remote learning strategy in mathematics poses minimal difficulty. Students' academic performance improved due to mathematics' modular distance learning technique. The kids' academic achievement was outstanding based on the percentage grade indicators. Different studies reported the factors that influenced the achievement of distance modular learning in mathematics education students. The results of these studies served as focal points for improving online mathematics teaching. The study of Wadsworth et al. (2007) disclosed that four learning strategies (motivation, concentration, information processing, and self-testing) and self-efficacy predicted online mathematics grade achievement. They suggested that online mathematics educators provide real-world examples and conduct student meetings regarding learning strategies. In a similar study, Glass and Sue (2008) showed that assignments were the most preferred learning object and had the most impact on learning. Thus, good practice drills and timely feedback were necessary for online mathematics education. The findings of Wadsworth et al. (2007) and Glass and Sue (2008) are consistent with the guidelines of Herrington et al. (2004).

The teacher takes the responsibility of monitoring the progress of the learners. The learners may ask for assistance from the teacher via e-mail, telephone, or text message/instant messaging, among others. Where possible, the teacher shall do home visits to learners needing remediation or assistance (Llego, n.d.). Printed Modules will be delivered to students, parents, or guardians by the teachers or through the Local Government Officials. Further, MDL involves individualized instruction that allows learners to use Self-Learning Modules (SLMs), whether printed or in digital format, which are centered on the Most Essential Learning Competencies (MELC) provided by DepEd (Martinez, 2020). Teachers provide learners with the SLMs, which include distribution and retrieval, as well as giving assessment tools to check for understanding and provide immediate and appropriate feedback.

This study generally aims to determine the use of modular distance learning in relation to the Problem-Solving skills in Statistics and Probability of Grade 11 Students in Bula National High School. It would also present supporting information related to the topic as it is an additional suggested modification in the learning content in the problem presented. (1.) What is the profile of the Grade 11 learners' pre-test scores of the Problem-Solving skills in Statistics and Probability utilizing the modular distance learning in terms of Analysis, Estimation and Approximation, Hypothesis Testing, and Applied Math.? (2.) What is the profile of the learners' post-test scores of the problem-solving skills in Statistics and Probability after their exposure to the modular distance learning? (3.) What are the significant change/s in the improvement of problem-solving skills brought by the utilization of modular distance learning among Grade 11 Learners? And lastly, (4.) How can these findings be used to apply to the lesson content and subject matter in Statistics and Probability?

2. Research Method

The researcher studied the Problem-Solving skills in Statistics and Probability of Grade 11 Students in Bula National High School, Schools Division of Camarines Sur. The researcher used the descriptive-evaluative-correlational method to determine the data needed under the present investigation.

2.1 Respondents

The respondents were the thirty (30) Grade 11 Students in Bula National High School, Bula Camarines Sur. These respondents were taken for the School year 2021-2022.

2.2 Data gathering instrument

A structured teacher-made test was employed to collect the information. Part I dealt with analysis, Part II dealt with estimation and approximation, Part III with hypothesis testing, and Part IV with applied mathematics. This research covered a total of 30 exam papers. Several master teachers from Bula National High School's Mathematics Grade 11 proofread and approved the test. If the test was gathered for the enhancement of the instrument, the instrument's dependability was assessed after the validation, suggestions, and recommendations on each item.

2.3 Data analysis

Mean and mean proficiency level was used to generate the level of participation of Grade 11 Students in Bula National High School. It was interpreted using the following scale:

2.3.1 Mean Proficiency level Rating Scale.

This was used to evaluate the pre-test and post-test of the learners developed. The following rating scale was used:

Scale	Interval	Verbal Interpretations
5	90 and above	Outstanding (O)
4	80-89	Very Satisfactory (VS)
3	74-79	Satisfactory (S)
2	66-73	Fairly Satisfactory (FS)
1	65 and below	Needs Improvement (NI)

The researchers sent a letter of approval to the school head of Bula National High School for permission to conduct the test for the Use of Modular Distance Learning in Relation to Problem-Solving Skills in Statistics and Probability of Grade 11 Students in Bula National High School. In addition, the researchers wrote a letter to the Superintendent of Public Schools in the district, requesting that the test for the Use of Modular Distance Learning in Relation to Problem-Solving Skills in Statistics and Probability be conducted.

2.4 Sampling Technique

The purposive and quota sampling were used in the choice of the locale of the study, which is the Bula National High School. A total enumeration was employed in selecting the Grade 11 learners as respondents under study.

3. Findings and Discussions

Part 1. The Profile of the Learners' Pre-Test Scores of the Problem-Solving Skills Utilizing the Modules.

At this premise, the researcher determined the profile of the learners' pre-test scores of the problem-solving skills utilizing the modules along with analysis, estimation and approximation, hypothesis testing, and applied math. The mean and mean proficiency levels were determined. The performance levels were interpreted as outstanding, very satisfactory, satisfactory, fairly satisfactory, and need improvement. Table 1 shows the results.

Table 1: The Profile of the Grade 11 Students in Problem Solving Skills Pre-Test Scores

Skills	Bula National High School		
	Mean	MPL	INT
1. Analysis	9.50	63.33	NI
2. Estimation & Approximation	7.37	73.67	FS
3. Hypothesis Testing	6.53	65.33	NI
4. Applied Math	9.73	64.88	NI
Average Mean		66.02	FS

As viewed in the tabular presentation, the pre-test scores of the 30 Grade 11 learners of Bula

National High School obtained the mean for analysis of 9.50 while the mean proficiency level was 63.33, for estimation and approximation, the obtained mean was 7.37, and the proficiency level was 73.67, for hypothesis testing the obtained mean and proficiency level were 6.53 and 65.33 respectively and the last skill which was applied big math schools got 9.73 as the mean and 64.88 as the mean proficiency level. Based on the school's data, the average mean for the pre-test obtained by the Grade 11 senior high school students of Bula National High School in problem-solving skills was 66.02 or "Fairly Satisfactory."

As disclosed by the table, it can be seen from the preceding data that most of the respondents of the school were good in Estimation and Approximation. But since the group did not meet the desired level of performance of 75%, there is a need to impose programs or strategies to improve the problem-solving skills in statistics and Probability of the Grade 11 students in Bula National High School. Further, this was supported by the research report of Alcantara (2015) that materials usage has already spread worldwide. Its use affects students' learning process worldwide, particularly in the field of mathematics. To assist students in grasping the lessons, teachers who support learning should plan and utilize many tactics and approaches.

Part 2. The profile of the learners' post-test scores of the problem-solving skills in Statistics and Probability after their exposure to the modular distance learning

Table 2 discloses the test results of the 30 Grade 11 Students as the respondents in Bula National High School on the given problem-solving skills post-test.

Table 2: The Profile of the Grade 11 Students in Problem Solving Skills Post-Test Scores

Skills	Bula National High School		
	Mean	MPL	INT
1. Analysis	11.73	78.22	S
2. Estimation & Approximation	8.00	80.00	VS
3. Hypothesis Testing	8.07	80.67	VS
4. Applied Math	11.43	76.22	S
Average Mean		78.78	S

For Analysis skills, the mean and proficiency levels were 11.73 and 78.22. At the same time, for estimation and approximation, they had 8.00 and 80.00, respectively. For hypothesis testing, there were 8.07 as the mean and 80.67 as the proficiency level; for applied math, the obtained mean was 11.43 and the proficiency level 76.22. It can be noted that the average mean of the whole test for the post-test results was 78.78, which was marked as "satisfactory."

Gleaned from the data, it is worth noting that the problem-solving skills in statistics and probability of the Grade 11 students in Bula National High School had improved significantly. This is a valuable achievement of the said group of learners to raise their ability to solve problems and make sound judgments. Indeed, the utilization of modules plays an important role in helping learners to solve problems mathematically by enhancing their background knowledge and fostering their ability and commitment to quality thinking.

The module is a complete and independent unit and consists of any learning activities organized to help learners in order so they can get their goals that are formulated specifically and clearly. Supported by Marcelo (2021) and Dangle (2020), as part of effective teaching practice, teachers communicate with parents, using multiple ways and both formal and informal means to meet the diverse needs of families and to better understand students' mathematical experiences outside of the school and students should acknowledge that the use of a modular remote learning strategy in mathematics poses minimal difficulty. Students' academic performance improved due to mathematics' modular distance learning technique.

Part 3. The significant changes in the improvement of problem-solving skills brought by the utilization of modular distance learning among Grade 11 Learners.

To determine if there is a significant change in the improvement of problem skills brought about by utilizing the modules based on the pre-test and post-test results. Hence, the t-test for the independent correlated sample was utilized. The results are presented in Table 3.

Table 3: Test of Significant Change in the improvement of problem-solving skills brought by the utilization of modular distance learning among Grade 11 Learners

Indicators	Bula National High School			
	Analysis	Estimation & Approximation	Hypothesis Testing	Applied Math
Mean	11.73	8.00	8.07	11.43
Mean Performance Level	78.22	80.00	80.67	76.22
Degrees of Freedom	29			
t-computed value	-5.3982			
t-tabular value	2.045			
Decision on H_1	accepted			
Level of significance	0.05			

Contained in the table were the Mean and Mean Proficiency level of the different abilities among the grade 11 learners of Bula National High School, the degrees of freedom, and the Computed and tabular t values at 0.05 level of significance.

Consequently, the data revealed that the computed t-Test value of -5.3982 was beyond the tabular t value of 2.045 at a 0.05 level of significance with 29 degrees of freedom. Thus, the researcher's alternative hypothesis was accepted, indicating that significant improvement existed. This further implies that the utilization of modular distance learning in statistics and probability is effective. When the role of teachers is to facilitate rather than to teach, learners are expected to be independent, self-control, and assess their thinking. Learners are taught to be able to identify and analyze the information in a situation, especially when the situation is complex and ambiguous, and learners can analyze the information to assess the justification. Therefore, there is a significant change in the improvement of problem-solving skills in statistics and probability brought about by the utilization of modular learning among Grade 11 Bula National High School learners.

These findings agreed with the results of Cassibba (2020) that besides relaying mathematical information, students must become independent learners, critical thinkers, and problem solvers;

through the use of a modular approach, those are skills that students can transfer to other areas of their life outside of the classroom it can also support the development of the ability to think creatively, critically, and logically, the ability to structure and organize and the ability to process information.

Part 4. Application of findings in the content and subject matter In Statistics and Probability

In the light of the study's findings, the following applications were arrived at: (1) The students' performance in Statistics and Probability, particularly in problem-solving, should be monitored and evaluated by their teachers to determine their strengths and weaknesses. (2.) All students take responsibility for their learning as they progress through elementary and secondary school. Understanding the skills and concepts connected with learning in the mathematics curriculum requires a commitment to learning. (3.) Students who are engaged in their learning and have opportunities to solve interesting, applicable, and meaningful problems must adopt practices and behaviors that support mathematical thinking. (4.) Teachers who support learning should plan and utilize many tactics and approaches to assist students in grasping the lessons. (5.) The use of modular distance learning in this pandemic creates intellectual inquiry, allowing learners to form ideas, take risks, make mistakes, critically think, fix mistakes, and learn how to solve those mistakes. (6.) Module writers must be provided with adequate training to produce self-learning modules that give an ideal opportunity for learners to learn and practice problem-solving skills. (7.) School heads and Department heads should implement policy changes designed to improve schools through their facilities, learning materials, and equipment while aiming to improve students' performance.

4. Conclusion

The findings show that the 30 Grade 11 learners of Bula national high school have the general average mean proficiency level of 66.02 on the pre-test scores in problem-solving skills of the Grade 11 students utilizing the modular distance learners, which is marked as fairly satisfactory. However, after their exposure to modular distance learning, they obtained 78.78, which was marked as satisfactory and indicated a significant improvement. This is a valuable achievement of the said group of learners to raise their ability to solve problems and make sound judgments. The utilization of modules plays an important role in helping learners to solve problems mathematically by enhancing their background knowledge and fostering their ability and commitment to quality thinking. In the light of the Hypothesis testing indicating that significant improvement exists, the alternative hypothesis is accepted. There is a significant change in the improvement of problem-solving skills brought by using modular distance learning among Grade 11 Learners. Through the use of the modular approach, those are skills that students can transfer to other areas of their life outside of the classroom. It can also support the development of the ability to think creatively, critically, and logically, structure and organize, and process information. This will imply that using modular distance learning in statistics and probability is effective. And Lastly, in the application of the findings to be used in the subject matter, it is highly marked that role of the teacher is to facilitate rather than to teach; learners are expected to be independent, have self-control, and assess their thinking. Learners are taught to identify and break down the information in a situation, especially when the situation is complex and ambiguous. Learners can analyze the information to assess the justification.

Furthermore, in the light of the findings and conclusions, it is highly recommended that the learners' problem-solving skills utilizing the modules be further enhanced; teachers and module developers should plan and prepare holistically to facilitate learners in analysis, estimation

approximations, hypothesis testing, and applied math, Teachers should Continue to monitor students' performance in order to ensure that their skills are progressing, Teachers and module developers should integrate into the modules learning activities based on inquiry method, etc. that are consistent with the development of problem-solving skills of learners and the findings to be used should be considered and adopted by the teachers in order to ensure that the problem-solving skills of the students will be enhanced.

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References

- Alcantara (2015). *Critical thinking and problem solving skills in mathematics of Grade 7 public secondary students*. https://www.researchgate.net/profile/Emil-Alcantara/publication/326058813_Critical_Thinking_and_Problem_Solving_Skill_in_Mathematics_of_Grade7_Public_Secondary_Students/links/5b3c6637aca27207850a97d4/Critical-Thinking-and-Problem-Solving-Skills-in-Mathematics-of-Grade-7-Public-Secondary-Students.pdf
- Alcantara. (2015). *Teaching and learning with technology: Ramification of ICT integration in mathematics education*. https://scholar.google.com.ph/citations?view_op=view_citation&hl=en&user=LV8VFQkAAAAJ&citation_for_view=LV8VFQkAAAAJ:zYLM7Y9cAGgC
- Antonio. (2018). *Difficulties in mathematics: Its implication to the academic performance of Grade 12 ABM students SY: 2018-2019*, <https://ojs.aaresearchindex.com/index.php/aasgbcjpmra/article/view/1433>
- Antonio, (2018). *Learning in mathematics: Difficulties and perceptions of students*. https://www.researchgate.net/publication/328772457_Learning_in_Mathematics_Difficulties_and_Perceptions_of_Students
- Avila, E. C., Abin, G. J., Bien, G. A., Acasamoso, D. M., & Arenque, D. D. (2021). Students' perception on online and distance learning and their motivation and learning strategies in using educational technologies during COVID-19 pandemic. *Journal of Physics: Conference Series*, 1933(1), 012130.
- Avila, E. C., & Lavadia, S. M. K. (2019). Investigation of the acceptability and effectiveness of academic podcasts to college students' scholastic performance in science. *Indian Journal of Science and Technology*, 12(34), 1–8.
- Pepin, B., Guedet, G., & Trouche, L. (2017). Refining teacher design capacity: Mathematics teachers' interactions with digital curriculum resources. *ZDM*, 49, 799–812. <https://link.springer.com/article/10.1007/s11858-017-0870-8>

- Canales, A. (2021). *Effectiveness of modular distance learning in mathematics in the new normal: A literature review*. www.globalscientificjournal.com
- Cassibba. (2020). *Teaching mathematics at distance: A challenge for universities*. <https://www.mdpi.com/2227-7102/11/1/1>
- Dangle, Y. R. P., & Sumaoang, J. D. (November 2020). *The implementation of modular distance learning in the Philippine secondary public schools*. <https://www.dpublication.com/wp-content/uploads/2020/11/27-427.pdf>
- De Vera. (2017). *Status of mathematics researches in ilocos region: Basis for mathematics research agenda*. <http://www.apjmr.com/wp-content/uploads/2016/08/APJMR-3.5.4.18.pdf>
- Glass., & Sue. (2008). *A case study on Online Mathematics Teaching with Pen-based Technology: Experiences of Two Instructors*, <https://files.eric.ed.gov/fulltext/EJ1105757.pdf>
- Herrington et al. (2004). *A development research agenda for online collaborative learning* <https://link.springer.com/article/10.1007/BF02504718>
- Henningsen., & Stein. (2018). *Examining the types of mathematical tasks used to explore the mathematics instruction*, <https://www.researchgate.net/publication/271292989>
- Lipman. (2017). *Enhancing achievement and interest in mathematics learning through Math-Island*. <https://telrp.springeropen.com/articles/10.1186/s41039-019-0100-9>
- Marcelo. (2021). *The future of Mathematics Education since COVID 19*. <https://link.springer.com/article/10.1007/s10649-021-10043-2>
- Martinez. (2020). *Online teaching-learning in higher education during lockdown period of COVID-19 pandemic*. <https://www.sciencedirect.com/science/article/pii/S2666374020300121>
- Vera. (2017). *Digital curriculum resources in mathematics education: foundations for change*, <https://link.springer.com/article/10.1007/s11858-017-0879-z>
- Wadsworth et al. (2007). *Mathematics self-related beliefs and online learning*. <https://files.eric.ed.gov/fulltext/EJ1095721.pdf>

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