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Introduction

Research is an activity which subscribes to constructivism. It is a form of problem-based learning where one develops higher order thinking skills while experiencing and solving real life problems. Doing research as a scientific process of inquiry enhances critical thinking skills and creativity. The application of independent and analytical thinking by research is cyclical in nature, it starts with identifying a problem and finding a solution for the problem. It culminates with informing others about the solution and may give birth to another research study.

The Department of Education has recently strengthened its policy development framework through DepEd Order No. 13, s. 2015 (*Establishment of Policy Development Process at the Department of Education*) which promotes **evidence-based policy formulation** supported by research. To reinforce the policy in providing mechanisms in conducting research, **DepEd Order No. 43, s. 2015** and **DepEd Order No. 4, s. 2016** (*Revised Basic Education Research Fund (BERF) Guidelines*) were formulated serving as the reference for **DepEd Order No. 39, s. 2016** *(Adoption of the Basic Education Research Agenda),* which provides the different research agenda anchored on the vision, mission and core values of the Department of Education, and in consonance with the implementation of **DepEd Order No. 16, s. 2017** known as "*Research Management Guidelines*.".

As means of disseminating the results of studies conducted in the Schools Division of Nueva Vizcaya, a Research Journal named ***EduCares*** containing various research geared towards improving Division's ARCA (Access, Retention, Promotion and Achievement) for the benefit of the A^2LL^2 (Advance, Average, Least, Lost, and Last) learners is being annually published.

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ASSESSMENT OF INTENSIVE EARLY READING INTERVENTION: BASIS FOR AN ENHANCED CLUSTER-BASED READING PROGRAM

DARLENE C. DERIJE
Principal I
Bantinan Elementary School

Abstract

This study assessed the intensive early reading intervention of Lawed, Bantinan and Cauco Elementary Schools in the District of Santa Fe as basis for an enhanced cluster-based reading program. Specifically, this study described the existing reading program in the schools; the extent of implementation; the schools' reading level based on pretest and posttest reading scores of Grades 1-3 pupils; the significant differences between the pretest and the posttest reading scores of the pupils; and the challenges encountered by the implementers of the reading program. This study involved the cluster schools of Lawed ES, Bantinan ES, and Cauco ES (LaBanCa). 145 pupils in the clustered schools and the 8 teachers were purposively chosen as the participants of the study. Data on reading level were determined through the pretest and posttest mean scores using the EGRA and differences of the pretest and posttest mean scores were determined using the t-test. Responses as to the level of implementation of the reading program and the challenges encountered in its implementation were gathered from the respondent teachers. Findings showed that the existing school reading programs were implemented at a high level. The pretest means scores significantly increased in Grades 1 and 3, but are still described as low, particularly in listening and reading comprehension, as well as in dictation. Teachers considered the lack of guides, instructional materials and training as the greatest challenge in the teaching of reading. The designed cluster-based enhanced reading program may help improve reading performance of pupils.

Keywords: EGRA, extent of implementation, reading performance

Introduction

Reading is the foundation in all academic learning. Learning to read, write, and count is crucial to a child's success in school and in later life. Literacy improvement is one of the priorities of the Department of Education. This is anchored on the flagship program of the Department, "Every Child A Reader Program" which aims to make every Filipino child a reader and a writer at his own grade level. (DepEd Order No. 14, s. 2018).

As affirmed by Claessen et al, (2020), reading difficulties prevail in the whole world. The Programme for International Student Assessment (PISA), a worldwide study by the Organization for Economic Cooperation and Development (OECD) that examines students' knowledge in Reading, Mathematics, and Science, reported in 2018 that reading is among the areas that learners struggle with. Among 79 participating countries, the Philippines scored the lowest in reading comprehension. Reading was the main subject assessed among 15-year-old students.

This, being the case, the Department of Education launched "Hamon: Bawat Bata Bumabasa (3Bs Initiatives)" (DepEd Order No. 173, s. 2019), in order to

intensify the advocacy for reading and to pledge commitment to make every learner a reader at his grade level. In response to DepEd's 3Bs initiatives, schools have its reading programs which have been assessed to determine the reading ability and the reading profile of learners.

It is of great hope that these learners who have reading difficulties can still overcome them by means of a suitable reading environment, functional and effective reading programs and sufficient family support. These are the indispensable issues that must be addressed.

Estromera and Estromera (2017) mentioned that it is essential that schools have to conduct regular assessment of their learners' reading performances. The results of the reading assessment can serve as basis for designing a reading program that would meet the abilities, interests, and needs of the student.

Hence, this study was conducted to assess the existing reading programs of Lawed, Bantinan and Cauco Elementary Schools, the results of which were used to formulate a cluster-based reading program that served the three respondent schools.

Objectives of the Study

The study intended to assess the implementation of school reading programs of cluster schools of Lawed, Bantinan and Cauco Elementary School (LaBanCa), Santa Fe District. The study focused on:(1) identifying the various reading programs implemented in the cluster schools; (2) assessing the level of implementation of the reading program of the school; (3) assessing the school's reading level based on the pretest and posttest assessment; (4) comparing the differences in the pretest and posttest reading scores of the early reading learners; (5) determining the challenges met by the implementers of the school reading; and (6) improving the implementation of the school reading programs.

Methods

The research employed descriptive correlational method. This study involved 8 teachers, 145 pupils, and was conducted in the clustered schools of Lawed, Bantinan and Cauco, Santa Fe District, Nueva Vizcaya.

The researcher determined the reading level of each school through the use of the EGRA tool. A questionnaire patterned after an article from Readability Tutor (2022) on how to evaluate reading programs was used to assess the extent to which the different school reading programs were implemented and the challenges encountered by the teachers in the implementation of the school reading program by using a scale and range with corresponding qualitative description. The teachers used the rubrics to rate the performance of pupils during the pretest and posttest assessments. Data gathered were treated statistically using mean, frequency, percentage, rank, and t-test.

Results and Discussion

Reading Programs Implemented in the Cluster Schools in the District of Santa Fe

The school reading program of the Cluster -Schools were as follows Reading Rescue and Recover (3Rs) in Bantinan Elementary School; Project I-Reform (Improving Reading performance in Lawed Elementary School and Project STAR

(Strengthening Learners Ability on Reading through Various Strategies) for Cauco Elementary School.

These school reading programs were designed to overcome the weaknesses of learners who fall under the very low mastery, low mastery based on the Early Grade Assessment (EGRA) Pre-test Result of learners. These have been organized to help learners overcome their reading difficulties as soon as possible. To ensure success of the poor readers, the reading teachers coordinate with the parents of the clienteles, improved remedial reading program, prepared contextualized instructional materials, employed differentiated instruction strategy, and intensified the reading enhancement activities and mechanisms as indicated in the Class Program of teachers.

Level of Implementation of the Reading Programs

Table 1. Teachers' Assessment on the Extent of Implementation of School Reading Program

	Indicators	Weighted Mean	Qualitative Description
1.	Program is designed with appropriately levelled reading	3.50	Strongly Agree
2.	Children have access to built-in assistance in the reading program	3.79	Strongly Agree
3.	A comprehensive reading program offers audiobook options.	3.89	Strongly Agree
4.	The reading program emphasizes vocabulary enrichment.	3.73	Strongly Agree
5.	Reading programs include high/low books	3.33	Strongly Agree
6.	A reading program gauges comprehension.	3.77	Strongly Agree
7.	A reading program should review reading progress.	3.91	Strongly Agree
	Overall Mean	**3.74**	**Very High**

The level of implementation of the reading program, which was described as very high, indicates positive support among the teachers and they believe that this could help improve the reading competencies, which are perennial among pupils. The assurance that the reading program was crafted to address the reading deficiencies of learners, most especially in the lower primary grades. Thus, the existing reading intervention contains the elements of an effective reading program.

Schools' Reading Level Based on the Pretest and Posttest Assessment

Table 2. Reading Level Based on the Pretest of Grade 1 Pupils of the Three Elementary Schools in the District of Santa Fe

	Mean and Qualitative Description						Overall Mean and Qualitative Description	
	Bantinan		Cauco		Lawed			
Orientation to Print	Observed		Observed		Observed		Observed	
Letter Name Knowledge	20.47	VLM	36.87	LM	19.1	VLM	25.49	VLM
Letter Sound Knowledge	40.91	LM	44.40	LM	19.7	VLM	35.01	LM
Initial Sound Knowledge	42.75	LM	46.07	LM	3	VLM	30.61	LM
Familiar Word Reading	15.41	LM	21.87	LM	6.43	VLM	14.57	LM
Invented Word Reading	13.03	LM	24.87	LM	6.14	VLM	14.68	LM
Oral Passage Reading	7.06	VLM	9.67	VLM	4.86	VLM	7.20	VLM
Reading Comprehension	0.97	VLM	1.47	VLM	0.29	VLM	0.91	VLM
Listening Comprehension	2.94	VLM	2.40	VLM	1.71	VLM	2.35	VLM
Dictation	2.47	VLM	2.07	VLM	0	VLM	1.51	VLM
General Mean	**16.29**	**L**	**21.08**	**L**	**6.08**	**L**	**14.73**	**L**

The general computed mean of the reading level of pupils in the pretest implied that they are still struggling with letter sound knowledge; specifically initial sounds. Thus, it is expected that they will find difficulty in the next higher competencies, with special mention to reading comprehension. This was an indication that they were at the frustration level in their reading proficiency level.

Table 3. Reading Level Based on the Posttest of Grade 1 Pupils of the Three Elementary Schools in the District of Santa Fe

	Mean and Qualitative Description						Overall Mean and Qualitative Description	
	Bantinan		Cauco		Lawed			
Orientation to Print	Observed		Observed		Observed		Observed	
Letter Name Knowledge	30.22	LM	47.47	LM	22.57	VLM	33.42	LM
Letter Sound Knowledge	59.41	MTM	55.67	MTM	22.29	VLM	45.79	LM
Initial Sound Knowledge	37.81	LM	56.47	MTM	7.43	VLM	33.90	LM
Familiar Word Reading	26.44	MTM	32.67	MTM	13.71	LM	24.27	LM
Invented Word Reading	28.94	MTM	35.40	MTM	8.43	VLM	24.26	LM
Oral Passage Reading	25.94	LM	19.87	LM	13.14	VLM	19.65	LM
Reading Comprehension	2.97	LM	2.60	LM	0	VLM	2.19	VLM
Listening Comprehension	3.88	LM	2.60	LM	2.14	LM	2.87	LM
Dictation	4.13	LM	2.67	LM	5.00	MTM	3.93	LM

The reading programs implemented in the schools do not work well as expected, not because of the program itself, but perhaps on how these are implemented. There were various factors that influenced the full implementation of the program and early reading proficiency of the learners, such as pupils, teachers, home, and community factors.

Table 4. Reading Level Based on the Pretest of Grade 2 Pupils of the Three Elementary Schools in the District of Santa Fe

	Mean and Qualitative Description						Overall Mean and Qualitative Description	
	Bantinan		Cauco		Lawed			
Orientation to Print	Observed		Observed		Observed		Observed	
Letter Name Knowledge	32.82	LM	67.90	M	28.80	LM	43.17	LM
Letter Sound Knowledge	30.51	LM	76.20	M	26.20	LM	44.30	LM
Initial Sound Knowledge	5.49	VLM	9.50	VLM	82.20	M	32.40	LM
Familiar Word Reading	24.05	LM	39.30	LM	29.20	LM	30.85	LM
Invented Word Reading	20.62	LM	35.50	LM	14.60	VLM	23.57	LM
Oral Passage Reading	17.97	LM	5.50	VLM	34.20	MTM	19.22	LM
Reading Comprehension	1.08	VLM	2.60	VLM	1.60	VLM	1.76	VLM
Listening Comprehension	1.00	VLM	3.90	VLM	5.00	MTM	3.30	LM
Dictation	0.82	VLM	0.60	VLM	5.80	MTM	2.41	LM

The second graders of these three schools have not developed their reading competencies prescribed for Grade 2 pupils. They lack the skills in reading that should have been taught and mastered when they were in grade one. In other words, learning to read builds on these pre-reading skills; otherwise, they shall have the strong foundation to learn how to read with understanding.

Table 5. Reading Level Based on the Posttest of Grade 2 Pupils of the Three Elementary Schools in the District of Santa Fe

	Mean and Qualitative Description						Overall Mean and Qualitative Description	
	Bantinan		Cauco		Lawed			
Orientation to Print	Observed		Observed		Observed		Observed	
Letter Name Knowledge	30.03	LM	40.54	LM	53.40	MTM	41.32	LM
Letter Sound Knowledge	27.37	LM	39.60	LM	37.20	LM	34.72	LM
Initial Sound Knowledge	7.63	VLM	7.80	VLM	91.80	M	35.74	LM
Familiar Word Reading	22.39	LM	25.88	LM	39.80	M	29.36	MTM
Invented Word Reading	19.87	LM	23.08	LM	40.80	M	27.92	MTM
Oral Passage Reading	23.24	LM	28.09	MTM	49.60	M	33.64	MTM
Reading Comprehension	1.37	VLM	2.04	VLM	3.40	LM	2.27	VLM
Listening Comprehension	1.24	VLM	1.93	VLM	5.00	MTM	2.72	LM
Dictation	0.82	VL	1.75	VLM	6.40	MTM	2.99	LM

The reading comprehension was the bugbear of the pupils and the teachers, as well. This could be accounted to the failure of the pupils to gain full mastery of the foundation skills of reading, such as knowledge of letter names and sounds. Despite the finding that Lawed Elementary School demonstrates mastery in some reading skills, it was surprising that they have low mastery in letter sound knowledge and

reading comprehension; whereas Bantinan Elementary School and Cauco Elementary School have either low or very low scores in practically all reading skills.

Table 6. Reading Level Based on the Pretest of Grade 3 Pupils of the Three Elementary Schools in the District of Santa Fe

	Mean and Qualitative Description						Overall Mean and Qualitative Description	
	Bantinan		Cauco		Lawed			
Orientation to Print	Observed		Observed		Observed		Observed	
Letter Name Knowledge	38.38	LM	63.50	MTM	55.00	MTM	52.29	MTM
Letter Sound Knowledge	80.71	M	66.83	MTM	54.60	MTM	67.38	MTM
Initial Sound Knowledge	8.96	M	7.33	MTM	5.00	LM	7.10	MTM
Familiar Word Reading	24.00	LM	29.42	MTM	30.60	MTM	28.01	MTM
Invented Word Reading	26.83	MTM	26.58	MTM	20.20	LM	24.54	LM
Oral Passage Reading	33.58	MTM	34.08	MTM	25.60	LM	31.09	MTM
Reading Comprehension	1.42	VLM	3.25	LM	2.20	VLM	2.29	VLM
Listening Comprehension	0.71	VLM	2.92	VLM	2.20	VLM	1.94	VLM
Dictation	2.92	VLM	3.50	LM	1.60	VLM	2.67	VLM

The reading comprehension, listening comprehension, and dictation were consistently very low from Grade 1 to Grade 3. Their backlog as well as their skills were supposed to develop in the next grade since it becomes more difficult for them to obtain and passed through the next grade level.

Table 7. Reading Level Based on the Posttest of Grade 3 Pupils of the Three Elementary Schools in the District of Santa Fe

	Mean and Qualitative Description						Overall Mean and Qualitative Description	
	Bantinan		Cauco		Lawed			
Orientation to Print	Observed		Observed		Observed		Observed	
Letter Name Knowledge	55.04	MTM	87.67	M	82.00	M	74.90	M
Letter Sound Knowledge	83.75	M	90.92	M	81.60	M	85.42	M
Initial Sound Knowledge	9.25	M	8.75	M	9.20	M	9.07	M
Familiar Word Reading	28.17	MTM	41.08	M	38.00	M	35.75	MTM
Invented Word Reading	30.00	MTM	35.00	MTM	30.80	MTM	31.93	MTM
Oral Passage Reading	38.33	MTM	42.25	MTM	25.80	LM	35.46	MTM
Reading Comprehension	2.88	LM	4.08	LM	3.80	LM	3.59	LM
Listening Comprehension	2.54	VLM	3.67	LM	1.40	VLM	2.54	LM
Dictation	3.75	LM	4.92	MTM	2.20	LM	3.62	LM

It can be construed that despite the reading programs in the district of Santa Fe, these three particular schools have common reading skills deficiencies, most particularly in reading comprehension, listening comprehension, and dictation. This can be explained by the fact that the pupils who do not master the fundamental skills in reading would end up struggling with reading comprehension.

Significant Differences in the Pretest and Posttest Reading Scores of the Early Reading Learners

Table 8. Summary of t-test Computation on the Difference between the Pretest and Posttest Reading Scores of the Early Reading Learners of Grade 1 Pupils

	Computed t-value	p-value	Remarks
Letter Name Knowledge	1.55	0.12	Not Significant
Letter Sound Knowledge	5.18	0.000	Significant
Familiar Word Reading	7.32	0.000	Significant
Invented Word Reading	7.20	0.000	Significant
Oral Passage Reading	10.60	0.000	Significant
Listening Comprehension	4.32	0.000	Significant
Reading Comprehension	9.03	0.000	Significant
Dictation	6.96	0.000	Significant

There is a notable increase in pupils' mean scores after participating in the district's reading programs, though the scores still remain low. This improvement does not indicate mastery of the targeted reading skills. Additionally, Grade 1 learners did not meet the expected reading outcomes for their level.

Table 9. Summary of t-test Computation on the Difference in the Pretest and Posttest Reading Scores of the Early Reading Learners of Grade 2 Pupils

	Computed t-value	p-value	Remarks
Letter Name Knowledge	0.11	0.91	Not Significant
Letter Sound Knowledge	0.06	0.95	Not Significant
Initial Sound Knowledge	1.74	0.08	Not Significant
Familiar Word Reading	0.99	0.33	Not Significant
Invented Word Reading	1.00	0.32	Not Significant
Oral Passage Reading	1.52	0.13	Not Significant
Listening Comprehension	1.01	0.32	Not Significant
Reading Comprehension	0.94	0.35	Not Significant
Dictation	0.23	0.82	Not Significant

The pupils' reading skills have not improved despite participating in the district's reading programs. Various factors may have affected their progress, including influences from school, teachers, home, parents, peers, or even the pupils themselves. It's also possible that the current reading programs are not suited to the students' grade level. This indicates a need to review, modify, or enhance the programs to improve their effectiveness

Table 10. Summary of t-test Computation on the Difference in the Pretest and Posttest Reading Scores of the Early Reading Learners of Grade 3 Pupils

	Computed t-value	p-value	Remarks
Letter Name Knowledge	13.16	0.000	Significant
Letter Sound Knowledge	5.82	0.000	Significant
Initial Sound Knowledge	4.32	0.000	Significant
Familiar Word Reading	4.65	0.000	Significant
Invented Word Reading	3.61	0.000	Significant
Oral Passage Reading	3.29	0.002	Significant
Reading Comprehension	6.51	0.000	Significant
Listening Comprehension	5.61	0.000	Significant
Dictation	6.32	0.000	Significant

The increase in Grade 3 posttest scores suggests that the reading programs effectively match students' needs, abilities, and interests, with well-aligned materials and activities. Engaging and appropriately challenging lessons likely encouraged active participation, helping students develop both a love for reading and a consistent reading habit.

Conclusions and Recommendations

The pretest scores for grades 1-3 in the EGRA assessment indicated very low levels of proficiency across nearly all reading competencies, particularly in listening and reading comprehension, as well as dictation. In the posttest, Grade 1 scores remained low across the three schools, except for Lawed ES, which showed progress toward a mastery level. Grade 2 and Grade 3 scores also remained low, especially in listening and reading comprehension and dictation. Although Grade 1 saw significant improvement in posttest scores, Grade 2 showed no significant increase, while Grade 3 showed a significant but still low level of mastery. While the objective of the school reading programs to improve reading competencies was assessed as highly implemented, students' reading outcomes remained low. Teachers in the cluster schools face several challenges, including a lack of suitable reading materials and instructional guides, low student interest, high absenteeism, limited parental

support, and insufficient training for teachers. A cluster-based enhanced reading program has been designed to address these reading deficiencies among students and support teachers in overcoming instructional challenges.

Grade 1 is critical for building the foundation of reading skills, and teachers have a responsibility to teach and develop the essential reading skills that prepare students for more advanced learning. The cluster-based enhanced reading program is intended to improve students' reading performance, but it should be regularly monitored to ensure that all suggested activities are implemented, allowing for adjustments or modifications as needed. Parents should be encouraged to participate in their children's education by inviting them to the school, not to discuss financial matters, but to showcase their children's learning activities and accomplishments. The teachers' requests for training and instructional materials should be addressed by school officials, working in collaboration with reading experts and professors from higher education institutions. This research may also be expanded to include variables beyond those considered in this study.

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EFFECTS OF PROJECT ROBOTURO IN THE INTEREST AND PROFICIENCY LEVEL OF GRADE 11 STEM STUDENTS TOWARD ROBOTICS EDUCATION CURRICULUM INTEGRATION

HELEN ANGELICA V. GADIANO
Teacher II
Bintawan National High School

Abstract

Project RoboTURO aimed to address the growing demand for innovative educational solutions by leveraging Robotics education as a transformative tool for curriculum integration, aligning with the constructivist principles. A pretest and posttest design were employed in this study. Survey questionnaires and tests were given to Grade 11 STEM students to assess their interest and proficiency level in robotics. Results showed that the entry interest level and proficiency of the students were generally average and beginning at the pre-implementation phase, respectively. Further, a majority had an increase in interest and proficiency level during the post-implementation phase. The overall student feedback was encouraging, suggesting a favorable reception of the project. Findings underscored the implications of integrating robotics education into the curriculum through enhanced student engagement and skill development. Further exploration and development of the project's outcomes may be discussed, emphasizing the significance of incorporating robotics education as a dynamic and effective pedagogical tool.

Keywords: Curriculum integration, robotics, 21st century skills

Introduction

Robotics emerges as a multidisciplinary field that seamlessly integrates science, technology, engineering, and mathematics (STEM), holding the promise of enhancing students' problem-solving, critical thinking, creativity, and teamwork skills. The potential of educational robotics extends beyond skill development, offering a conduit for learning in various subjects such as Information and Communication Technology (ICT), physics, mathematics, and design.

The rapid advancement of technology has positioned educational robotics as an innovative and effective tool, propelling students into the era of the Fourth Industrial Revolution (4IR). This technological surge presents an opportunity for hands-on experiences with advanced technologies, creating a student-centered environment that fosters problem-solving skills. Papert's educational theory of Constructionism underlines the importance of student-centered and discovery learning, emphasizing tangible interactions with real-world objects to build knowledge. The essence lies in making the process of thinking and learning visible, allowing for a more process-oriented engagement through creation and deconstruction, with teachers evolving into facilitators rather than mere instructors (Papert, 1980).

The global surge in interest in educational robotics among students, educators, and policymakers has been palpable, spanning various corners of the world, including the Philippines. Li, Wang, and Li (2019) emphasize the role of

educational robotics in supporting the development of digital competencies and 21st-century skills across multiple subjects. However, despite this burgeoning interest, the impact of educational robotics on students' interest and knowledge levels in STEM and ICT fields remains a terrain not fully understood. It is within this context that the proposed project, "ROBOTuro," emerges, aspiring to delve into the nuanced effects of educational robotics on students' interest and knowledge in STEM and ICT fields.

Chesloff (2013) underscores the essence of the learning process in STEM education, emphasizing the cultivation of creativity, collaborative skills, and critical thinking. While STEM education holds the promise of bridging the gap between theoretical learning and authentic real-life scenarios, challenges such as lack of familiarity with STEM content, unstructured learning activities, and inadequate preparation of STEM curricula have been identified. These challenges often render the learning experience and real-life application intangible in certain areas (Moomaw, 2012; Conde et al., 2021).

Evripidou et al. (2020) stated that the development of multiple skills, including problem-solving, creativity, motivation, collaboration, cooperation, computational thinking, and other higher-order thinking skills, is intricately tied to a learner's interest. Research attests to the positive impact of educational robotics on students' academic performance, engagement, and motivation in STEM and ICT fields.

Spolaôr and Benitti's (2017) investigation into the use of robots in higher education underscores the effectiveness of experiential learning and project-based learning (PBL) theories. These pedagogical approaches contribute to students' motivation and skill development, aligning with the findings of Behrens et al. (2010) and Jou et al. (2010).

The study's discoveries carried implications for educational policy and practice, offering insights to shape the creation of impactful educational robotics programs that enhanced student academic engagement and motivation. Consequently, this initiative had the potential to motivate educators to incorporate educational robotics into their teaching methods and inspire students to consider careers in STEM. It was worth noting that Bintawan National High School lacked prior experience in Robotics Education as of the specified academic year, underscoring the significance of proposing that intervention. The proposal aimed not only to introduce students to robotics activities and competitions but also to equip them for potential future engagements in this field.

Objectives of the Study

The primary objective of this research is to investigate the impact of Project RoboTURO on the interest and proficiency levels of Grade 11 STEM students. More specifically, the study seeks to ascertain the initial levels of interest and proficiency among the participants, discern any substantial differences in these levels before and after the intervention, explore the significant correlations between interest and proficiency both pre- and post-intervention, and ultimately, derive recommendations for enhancing the implementation of the intervention.

Methods

The study employed a mixed-methods research design, incorporating both quantitative and qualitative approaches to address various research questions. Specifically, a quasi-experimental methodology was adopted for comparing variables, utilizing pre- and post-tests along with a Likert scale questionnaire for data collection. A correlational research design was applied to examine the relationships between variables before and after the intervention. The study involved 63 Grade 11 STEM students from Bintawan National High School as participants. To analyze the collected data, the study employed statistical measures including mean percentage score, standard deviation, t-test, and Pearson correlation. Additionally, thematic analysis was utilized for qualitative data, providing a comprehensive approach to determine the effectiveness of the Project ROBOTuro.

Results and Discussion

Interest level of Grade 11 STEM students towards robotics education before and after the implementation of Project RoboTURO

Table 1. Summary of Interest Level toward Robotics Education

Interest Level Descriptor	Control Group				Experimental Group			
	Pre-Implementation		Post-Implementation		Pre-Implementation		Post-Implementation	
	f	%	f	%	f	%	f	%
High Interest	11	33.33	20	60.61	9	30.00	12	40.00
Average Interest	18	54.55	12	36.36	16	53.33	17	56.67
Poor Interest	4	12.12	1	3.03	5	16.67	1	3.33
No Interest	0	0.00	0	0.00	0	0.00	0	0.00

In the control group, high interest increased by 27.28%, while average interest slightly decreased by 18.19%, and poor interest dropped by 9.09%. In the experimental group, high interest increased by 10%, average interest by 3.34%, and poor interest decreased by 13.34%. This indicates that the intervention boosted high interest, maintained average interest, and reduced poor interest, leading to a positive shift in attitudes toward robotics education in both groups. The findings align with Ericson and Mclin's (2012) study, where similar interventions involving creative computing activities showed increased student engagement.

Proficiency level of Grade 11 STEM students in robotics education

Table 2. Summary of Proficiency Level of Grade 11 STEM Students in Robotics Education

Interest Level Descriptor	Control Group				Experimental Group			
	Pre-Implementation		Post-Implementation		Pre-Implementation		Post-Implementation	
	f	%	f	%	f	%	f	%
Advanced	0	0.00	12	36.36	0	0.00	9	30.00
Proficient	0	0.00	17	51.51	0	0.00	16	53.33
Approaching Proficiency	0	0.00	4	12.12	2	6.06	5	16.67
Developing	0	0.00	0	0.00	2	6.06	0	0.00
Beginning	33	100.00	0	0.00	26	78.79	0	0.00

The control group showed a consistent proficiency level at the beginning stage before implementation. Post-implementation, there was a significant improvement,

with 12.12% of participants approaching proficiency, 51.51% reaching proficiency, and 36.36% achieving advanced levels. These results indicate a positive impact of the intervention on proficiency, supporting studies that associate robotics education with enhanced learning, motivation (Fagin and Merkle, 2003; Moundridou and Kalinoglou, 2008), and increased interest in STEM fields (Barnes, 2002; Robinson, 2005; Rogers and Portsmore, 2004). Specifically, Rogers and Portsmore (2004) and Moundridou and Kalinoglou (2008) found that robotics improved comprehension of scientific and mathematical principles.

Moreover, proficiency of the students in the experimental group during the pre-implementation phase was mostly (78.79%) at the beginning level. After the implementation of the intervention, there was an improvement in the proficiency level of students with 16.67% approaching proficiency, 53.33% proficient, and 30% advanced. Results suggest that the intervention had a positive effect on the proficiency level of the Grade 11 STEM students.

Difference in the pre- and post-implementation of Grade 11 STEM students

Table 3. Difference of Pre- and Post- Interest Level

Groups		Mean	SD	df	t-critical	p-value	Effect Size
Experimental	pre	3.07	0.54	32	2.05	0.10	0.56
	post	3.31	0.43				
Control	pre	3.23	0.49	29	0.01	2.04	0.74
	post	3.53	0.41				

The computed probability value of the experimental group (p=0.10) showed a statistically significant improvement in pre- and post-interest levels, suggesting a positive impact from the intervention. An effect size of 0.56, classified as medium, reinforced the practical significance of this impact. In contrast, the control group's p-value of 2.04 lacks statistical significance, but its medium effect size of 0.74 indicated a meaningful practical impact on interest levels. These results highlight the importance of considering both statistical and practical significance when evaluating the effects of interventions on interest levels.

Table 4. Difference of Pre-/Post- Proficiency Level

Groups		MPS	SD	df	t-critical	p-value	Effect Size
Experimental	pre	32	3.77	32	2.78	0.000	1.7
	post	77.	8.48				
Control	pre	30	5.13	29	2.78	0.000	2.1
	post	65	6.92				

The analysis revealed significant improvements in pre- and post-proficiency levels for both the experimental and control groups, with very low p-values of 0.000 and 0.000, respectively, indicating strong statistical significance. Additionally, the large effect sizes—1.7 for the experimental group and 2.1 for the control group—highlighted substantial practical significance. These results demonstrated meaningful impacts on proficiency levels for both groups, underscoring the effectiveness of the interventions in producing notable gains in proficiency. The combination of statistical and practical significance emphasizes the strength and impact of the interventions on proficiency levels.

Correlation of the interest and proficiency level of the Grade 11 STEM students

Table 5. Relationship of Pre-Post Implementation (Level of Interest and Proficiency Level)

	Level of Interest		Proficiency Level			
		Mean Score		**Mean Score**	**r**	**p-value**
Experimental	pre	3.21	pre	14.33	0.3116	0.093697
	post	3.5	post	30.17	-0.9852	< .00001
Control	pre	3.01	pre	14	-0.1147	0.527587
	post	3.26	post	28.73	-0.0615.	0.73595

In the experimental group, pre-implementation analysis showed moderately positive relationship between interest and proficiency levels, with a correlation coefficient of 0.3116. Although the associated p-value was slightly above 0.05 (non-significant), this positive correlation suggested that higher interest generally aligns with higher proficiency before the intervention. Post-implementation showed that there was a notable shift, with a strong negative correlation coefficient of -0.9852 and a highly significant p-value (<.00001), indicating that, surprisingly, higher interest now correlated with lower proficiency levels. In contrast, the control group showed consistently weak, negative relationship between interest and proficiency both before and after the intervention, with non-significant p-values throughout.

Recommendation for the improvement of the implementation of the intervention

Table 6. Recommendations for the improvement of Project RoboTURO

Themes	Common Responses
Learning Environment	Provide a more conducive venue with enough ventilation, less noise from the surroundings. Add more training days.
Speaker/Facilitator	Include additional facilitators to accommodate slow learners and students having difficulty understanding the concept
Activities	Include small competition/ games to increase focus, motivation and fun from students.
Learning materials	Provide individual kits for students. Provide laptops and internet connectivity for a better experiential learning

Participants commonly highlighted several areas for improvement in the learning environment. They expressed a desire for a more conducive venue with better ventilation and reduced noise to create an optimal learning atmosphere. Many recommended extending training days, suggesting that the current duration may be insufficient. There's also a call for additional facilitators to address diverse learning needs, particularly for those who may require extra support with complex concepts. Adding small competitions and games were suggested to enhance student focus, motivation, and enjoyment. Regarding learning materials, participants requested individual kits to support personalized learning and proposed providing laptops and internet access, reflecting a recognition of technology's valuable role in enriching the educational experience.

Conclusions and Recommendations

The Grade 11 STEM learners exhibited an average interest level during the pre-implementation stage, which transforms into an average to high interest level post-implementation. Secondly, learners predominantly started at the beginning proficiency level pre-implementation, but post-implementation sees an increase ranging from approaching proficiency to advanced levels. Thirdly, there was a significant difference in interest levels between pre- and post-implementation stages, indicating a positive impact sustained through the intervention. Fourthly, the relationship between interest and proficiency levels was generally negative, yet this negative effect can potentially be turned into a positive one by implementing the recommendations provided by the students. Finally, student recommendations emphasized the importance of a conducive learning environment and advocated for fun, interactive, and experiential learning activities to enhance their focus and motivation.

There was a suggestion to create infographics, campaigns, and promotions highlighting the positive effects of Robotics Education, with potential inclusion in the school's Robotics and Research Club Action Plan for the upcoming school year. In addition, it was recommended to develop a cross-disciplinary integration of robotics in the curriculum, either as a standalone subject or as an integrated topic in other subjects. Moreover, exposing students to both school-based and out-of-school competitions was advised to sustain their interest and encourage participation in the robotics club. Furthermore, there was a call to innovate learning activities and materials, incorporating simulations, forums, competitions, and additional learning kits to create a more positive impact. Finally, the establishment of a Robotics laboratory was recommended, providing students with a conducive learning environment equipped with essential amenities like proper ventilation, gadgets, extension wires, internet connectivity, and maintenance facilities for existing learning kits.

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CHALLENGES AND LEVEL OF IMPLEMENTATION OF INDIGENOUS PEOPLES EDUCATION

REYNOLD B. MARIANO
Head Teacher III
Tiblac Elementary School and Daclig Elementary School

Abstract

This study examined the challenges and implementation status of the Indigenous Peoples Education Program (IPED) using a mixed methods research design. Survey questionnaires assessed the level of IPED implementation, while structured interviews identified challenges. Respondents were purposively selected from 16 elementary schools and 2 integrated schools. Mean and standard deviation were calculated to assess implementation levels, and thematic analysis with coaxial coding was used to analyze challenges. Findings revealed that many respondents worked in monograde schools without relevant IPED training, particularly in Ambaguio District where Kalanguya teachers are predominantly beginners. Implementation of IPED in Teaching Methods and Strategies, Teachers Capacity Building, Program Objectives, and curriculum showed satisfactory results, especially in teaching materials. However, certain areas, such as involving cultural bearers and enhancing teacher capacity building, did not achieve desired outcomes

Keywords: Contextualization, Localization Culture Bearers, Indigenous Cultural Communities, Indigenous Knowledge Systems and Practices

Introduction

Historically, Indigenous Peoples (IPs) in the Philippines have faced discrimination and limited access to education. They make up about 10% to 20% of the country's 102.9 million population. The neo-colonial background of the Philippine educational system creates barriers for cultural minorities (Gabriel and Eduardo, 2021). The Philippine Constitution (Art. XIV, Sec. 17) mandates the State to recognize, respect, and protect the rights of indigenous cultural communities (ICCs) to preserve and develop their cultures, traditions, and institutions, incorporating these rights into national plans and policies.

Aligned with DepEd's mandate for inclusive basic education, the Department aims to recognize, protect, and promote the rights and welfare of ICCs/IPs. This includes equipping them with the knowledge and skills to navigate social realities and challenges. Within the IP Education framework, the goals include: a.) respecting and recognizing Indigenous Knowledge Systems and Practices (IKSPs) in school and learning programs; b.) eliminating discrimination against learners due to their cultural identity; c.) adequately orienting and training teachers serving in indigenous communities to appreciate indigenous cultures and avoid labeling indigenous practices as "backward," "inferior," or "primitive"; d.) promoting respect for indigenous cultural expressions such as dances, chants, instruments, and attire, ensuring they are not misused or misrepresented in educational activities; and e.) fostering among learners an affirmation of indigenous cultural identity to sustain inter-generational relationships and cultural integrity in the community.

Republic Act 8190, known as the Localization Law, is used to appoint teachers in IP schools, and was strengthened by DO 50, s. 2016, which provides guidelines

for appointing teachers in IPED schools. Although many hired teachers are IPs, they often lack sufficient knowledge about the specific contexts of the IP communities where they work. Additionally, some teachers are not members of any IP group. This study was conceptualized to identify the challenges in implementing IP programs, specifically assessing the extent of programs, activities, and projects for IP learners as perceived by teachers, school heads, and participating schools.

Objectives of the Study

This study aimed to determine the level of implementation of Indigenous Peoples Education (IPED) in terms of teaching methods and strategies, teachers' capability building, program objectives, and curriculum and learning. Additionally, the study identified the challenges encountered by teachers and school heads in implementing the IPED program

Methods

This study used a mixed-method research design and assessed the challenges and implementation level of Indigenous Peoples Education (IPED). A questionnaire adapted on the study of Reyes (2022) was used, covering teaching methods and strategies, teachers' capability building, program objectives, and curriculum and learning. Participants included 77 teachers and 13 school heads from Ambaguio District elementary schools, chosen through purposive sampling. With approval from the Schools Division Office, questionnaires were ethically distributed to teachers. Data was collected confidentially and analyzed using frequency and percentage for participant distribution, mean and standard deviation for IPED implementation levels, and thematic analysis for challenges reported by teachers and school heads.

Results and Discussion

IPED Implementation along Teaching methods and strategies

Table 1. Mean Score and Standard Deviation on the IPED Implementation in terms of Teaching Methods and Strategies

	Indicators	Mean	SD	D
1.	Uses mother tongue (Tagalog) in literacy and numeracy instruction.	3.64	0.48	HI
2.	Contextualize and uses indigenous materials in teaching and learning.	3.50	0.50	HI
3.	Teaching other languages as a basis for cross-cultural understanding and tolerance	3.72	0.45	HI
4.	Use of the local language in teaching when appropriate.	3.72	0.45	HI
5.	Discussion of topics using local examples or situations.	3.61	0.49	HI
6.	Local knowledge and examples are included in the discussions.	3.61	0.49	HI
7.	Addition of core values such as self-determination, responsibility, identity.	3.52	0.50	HI
8.	Addition of local topics to subjects (ex. indigenous musical instruments)	3.41	0.55	I
9.	Inviting culture bearers from the community as speakers or lecturers for topics.	2.47	0.87	PI
10.	Involving culture bearers of IPED topics as teachers in ceremonies with family members, to learn about cultural significance of places, rituals, associated songs, dances, astrological observation, etc.	2.45	0.85	PI
	Total	**3.47**	**0.56**	**I**

Legend: D-Description, 1.00-1.49 (NI-Not Implemented), 1.50 – 2.49 (PI-Poorly Implemented), 2.50 – 3.49 (I-Implemented), 3.50 – 4.00 (HI-Highly Implemented)

The implementation of IPED in teaching methods and strategies is generally at an implemented level (Mean=3.47, SD=0.56), indicating satisfactory implementation by teachers and school heads. However, involving culture bearers in IPED topics and school activities was poorly implemented (Mean=2.45, SD=0.85),

suggesting a failure in this aspect. McCarty and Lee (2014) emphasized the crucial role of culture bearers and community members in education, contrasting with the limited participation found in this study. Strategies to integrate traditional knowledge and cultural practices into formal education are crucial for enhancing IPED effectiveness.

IPED Implementation on Teachers Capacity Building

Table 2. Mean and Standard Deviation on IPED Implementation along Teachers' Capability Building

	Indicators	Mean	SD	D
1.	Familiarize with indigenous culture.	3.47	0.50	I
2.	Familiarize with indigenous language.	3.59	0.49	HI
3.	Respect for indigenous beliefs and principles regarding IP education.	3.83	0.38	HI
4.	Respect indigenous concepts and values who engage in an interactive process with indigenous communities and students.	3.77	0.42	HI
5.	Utilize and develop responsive and innovative teaching approaches in cooperation with the IP leaders.	3.36	0.48	I
6.	Utilize and develop responsive and immersive instructional materials in cooperation with the IP leaders.	3.30	0.52	I
7.	Programs organized in collaboration with indigenous peoples' groups and communities.	3.31	0.61	I
8.	Facilities organized in collaboration with indigenous peoples' groups and communities.	3.22	0.70	I
	Total	**3.48**	**0.51**	**I**

Legend: D-Description, 1.00-1.49 (NI-Not Implemented), 1.50 – 2.49 (PI-Poorly Implemented), 2.50 – 3.49 (I-Implemented), 3.50 – 4.00 (HI-Highly Implemented)

Generally, IPED implementation in Teacher Capacity Building was at an implemented level (Mean=3.48, SD=0.51), indicating successful implementation with satisfactory results. Marker (2014) emphasized the importance of culturally relevant professional development for Indigenous educators. However, this study's findings contradicted this, revealing insufficient training for teachers.

IPED Implementation on Teachers Learning Materials

Table 3. Mean Score and Standard Deviation on the IPED Implementation along Teachers' Learning Materials

	Indicators	Mean	SD	D
1.	Learning objectives are aligned with the DepEd learning competencies.	3.73	0.44	HI
2.	Learning competencies are stated clearly and written from the student's perspective	3.63	0.48	HI
3.	Content is free from cultural, gender, racial, or ethnic bias.	3.66	0.47	HI
4.	Content stimulates and promotes critical thinking.	3.63	0.48	HI
5.	Content is relevant to real-life situations.	3.75	0.43	HI
6.	Language (including vocabulary) is appropriate to the target user level, including the use of local language.	3.52	0.53	HI
7.	Content promotes positive values that support formative growth.	3.70	0.46	HI
8.	Culturally responsive, sensitive, and appropriate curriculum that incorporates relevant Indigenous Knowledge, Skills, and Practices (IKSPs) in all learning levels and areas and articulates Indigenous Peoples' rights and practices in the education system.	3.55	0.50	HI
9.	Inclusive, gender sensitive, and culturally sensitive in developing the 21st century integrative skills.	3.70	0.46	HI
10.	Rooted in an ancestral domain that acknowledges, promotes, and protects Indigenous Knowledge, Skills, and Practices (IKSPs).	3.59	0.49	HI
11.	Develops IP learners' understanding of their identities.	3.67	0.50	HI
12.	Enhances the Indigenous Knowledge Systems and Practices (IKSPs) of learners in response to the demands of the global community.	3.53	0.53	HI

	Indicators	Mean	SD	D
13.	Discussion of concepts with local situations or examples and addition of local topics to subjects (e.g., indigenous musical instruments in music class aside from the usual instruments taught).	3.48	0.53	I
14.	Inclusion of local knowledge in the topics (e.g., local identification system of animals and plants, or land and water forms).	3.58	0.55	HI
	Total	**3.62**	**0.49**	**HI**

Legend: D-Description, 1.00-1.49 (NI-Not Implemented), 1.50 – 2.49 (PI-Poorly Implemented), 2.50 – 3.49 (I-Implemented), 3.50 – 4.00 (HI-Highly Implemented)

On average, IPED implementation in teachers' learning materials was highly implemented (Mean=3.62, SD=0.49), showing outstanding practice of the program. Specifically, discussing concepts with local examples and adding local topics to subjects were successfully implemented (Mean=3.48, SD=0.53). Garcia and Nguyen (2019) emphasized the importance of contextualizing learning resources to meet diverse student needs.

IPED Implementation on Program Objectives

Table 4. Mean Score and Standard Deviation on the IPED Implementation along Program Objectives

Indicators	Mean	SD	D
1. Establish rights-based partnership with IP communities to ensure inclusion, participation, and empowerment of Ips in the implementation of the IPED Program.	3.42	0.58	I
2. Make the curriculum culturally responsive to the IP learners' specific community.	3.44	0.56	I
3. Build the capacity of teachers, school heads, and other concerned personnel at different levels of governance in implementing culture-based education for IPs.	2.45	1.06	PI
4. Develop culturally appropriate learning resources and learning environments.	3.53	0.53	HI
5. Facilitate interfacing between IP communities and DepEd in education.	3.48	0.59	I
Total	**3.27**	**0.66**	**I**

Legend: D-Description, 1.00-1.49 (NI-Not Implemented), 1.50 – 2.49 (PI-Poorly Implemented), 2.50 – 3.49 (I-Implemented), 3.50 – 4.00 (HI-Highly Implemented)

The implementation of IPED program objectives was practiced and yielded satisfactory results (Mean=3.27, SD=0.66). However, building the capacity of teachers, school heads, and other personnel at different governance levels to implement culture-based education for IPs was unsuccessful (Mean=2.45, SD=1.06), indicating a failure to achieve desired outcomes. The findings underscored the need for additional training for teachers and school heads in IPED to effectively deliver culture-based education. Suazo and Montenegro (2018) argue that training and seminars in language proficiency and other educational materials were essential to support educators in IP education implementation.

IPED Implementation on Curriculum and Learning

Table 5. Mean Score and Standard Deviation along IPED Implementation on Curriculum and Learning

Indicators	Mean	SD	D
1. Provide leadership assistance to facilitate culturally sensitive and contextualized teaching and learning.	3.38	0.60	I
2. Assist teachers in promoting innovation advancements to allow the development of creative knowledge and the sharing of knowledge on IPEd.	3.44	0.61	I
3. Support continuing professional growth and development of teachers on IPEd.	2.44	0.70	PI
4. Encourage the use of local material resources as both educational providers and educational content.	3.67	0.50	HI

Indicators	Mean	SD	D
5. Encourage active and sustainable partnerships between educational contexts and the wider community.	3.56	0.56	HI
6. Facilitate collaboration between schools, parents, and community groups, and mobilize local resources within communities to build IPEd programs, so that communities may share their cultural values and local art forms.	3.53	0.56	HI
7. Encourage efficient documentation and sharing of knowledge between community elders, school leaders and teachers.	3.47	0.59	I
Total	**3.35**	**0.59**	**I**

Legend: D-Description, 1.00-1.49 (NI-Not Implemented), 1.50 – 2.49 (PI-Poorly Implemented), 2.50 – 3.49 (I-Implemented), 3.50 – 4.00 (HI-Highly Implemented)

The IPED implementation on curriculum was practiced with satisfactory results (Mean=3.35, SD=0.59). However, supporting the continuing professional growth and development of teachers in IPED (Mean=2.44, SD=0.70) was a failure. This implied that a smaller number of teachers were engaged in continuing professional growth. Battiste (2013) emphasizes the need for technical support to empower Indigenous educators, which was implemented with satisfactory results in this study, and argued for a curriculum that reflects Indigenous ways of knowing and learning, stressing the importance of culturally responsive pedagogy.

Challenges Encountered by Teachers and School Heads

Table 6. Thematic Analysis on the Challenges in the Implementation of IP Education

Themes	Challenges
Contextualization of Instructional Materials	Insufficient knowledge of the content of kalanguya culture and traditions.
Involvement of Culture Bearers	Poor establishment of partnership with the community bearers Non-Involvement of culture bearers in IPED topics as teachers in ceremonies with family members, to learn about cultural significance of places, rituals, associated songs, dances, astrological observation, etc.
Continuing Professional Growth	Unsatisfactory capacity building of teachers, school heads, and other concerned personnel at different levels of governance in implementing culture-based education for IPs. Insufficient continuing professional growth and development of teachers on IPEd. Insufficient knowledge on utilization and development of responsive and innovative teaching approaches in cooperation with the IP leaders.
Provision of Technical Assistance	Insufficient leadership assistance to facilitate culturally sensitive and contextualized teaching and learning.

Most respondents reported difficulty with contextualizing instructional materials, particularly in terms of content and engaging culture bearers. These challenges contradicted the findings of Lee and Chen (2019) and Williams and Anderson (2018), who highlighted the many benefits of contextualization.

Respondents also emphasized the need for continuous professional development and technical assistance to improve their practice. This aligns with Johnson and Thompson's (2018) assertion that effective contextualization requires ongoing professional growth for teachers. Professional development programs should focus on enhancing teachers' cultural competence, technological proficiency, and instructional strategies for better contextualizing learning resources.

Conclusions and Recommendations

The findings revealed that the level of IPED implementation along Teaching Methods and Strategies, Teachers Capacity Building, Program Objectives, and Curriculum and Learning was practiced with satisfactory results, while IPED

implementation along Teachers Learning Materials was outstandingly practiced. However, teachers and school heads have insufficient IPED training and have poorly established partnerships with culture bearers.

Based on the study's results and conclusions drawn, it is recommended to strengthen the partnership of schools with culture bearers. Conducting Learning and Development (L&D) sessions and Learning Action Cell (LAC) sessions on IPED was encouraged to enhance teachers' knowledge and implementation of IPED.

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UTILIZING GAMIFIED E-LEARNING APPLICATIONS IN EARTH AND LIFE SCIENCE IN ASSESSING MASTERY, MOTIVATION LEVEL AND EXPERIENCES OF GRADE 12 LEARNERS

KEVIN P. AQUINO
Teacher III
Bugkalot High School

Abstract

The main goal of this study was to foster students' curiosity in scientific concepts amidst global competition. ICT resources, including gamified e-learning applications, were instrumental in promoting scientific knowledge awareness. This study aimed to assess Grade 12 learners' mastery, motivation, and experiences using gamified e-learning in Earth and Life Science, employing a mixed-method, sequential explanatory approach. Results showed significant improvements in mastery from no mastery to mastery, alongside an increase in motivation levels from moderate to high post-intervention. Learners reported positive experiences and perceptions, highlighting the support gained for their learning. This underscores the importance of gamified e-learning in enhancing mastery and motivation, recommending its broader adoption across disciplines.

Keywords: *Gamified e-learning applications; game, mastery, motivation*

Introduction

In today's competitive world, it is essential to foster and sustain students' interest in scientific knowledge. Teachers should aim for students' progress and international recognition. ICT tools such as the internet, radio, TV, smartphones, and computers help spread scientific knowledge. As technology becomes more prevalent, gamification in education is becoming a popular trend.

Saleem et al. (2020) emphasize that gamification enhances motivation, user interaction, and social engagement by incorporating elements like points, badges, feedback, levels, rewards, and challenges in e-learning. These elements make learning more engaging, helping students improve their performance through interactive features such as badges and leaderboards (Barata et al., 2017). According to Ding (2019), the majority of learning experiences can be shaped from the students' perspective.

In the Philippines, a regular participant in the Programme for International Student Assessment (PISA), science literacy ranked second-lowest among 79 countries in 2018, with an average score of 340, slightly improving from 336 in 2015. By 2021, the average score rose to 511, reflecting improved scientific literacy, largely due to the shift toward digital skills and online learning during the pandemic. Gamification in science education is highly recommended, as Caballero et al. (2022) found it enhances academic performance. Research indicates that motivation is positively linked to academic success (Delfino, 2019). However, while gamification has been shown to improve online achievement, its effectiveness in offline settings remains underexplored.

At Bugkalot High School, where internet access is limited, using this educational trend to assess the mastery and motivation of Grade 12 learners in an offline setting posed a significant challenge.

During the first quarter examination in Earth and Life Science, item analysis revealed a mean score of 34.79 and a Mean Percentage Score (MPS) of 57.98, identifying the least mastered competencies. These included recognizing Earth's uniqueness as the only planet with properties necessary for life (S11/12ES-Ia-e-3), explaining Earth's four subsystems (S11/12ES-Ia-e-4), identifying common rock-forming minerals using their properties (S11/12ES-Ia-9), and comparing the formation of different types of igneous rocks (S11/12ES-Ic-18). In response, the researcher developed an offline gamified e-learning application using Hot Potato software.

Objectives of the Study

This study determined the mastery, motivation levels and experiences of Grade 12 learners in the utilization of gamified e-learning applications in Earth and Life Science for School Year 2023 – 2024 at Bugkalot High School, Dupax Del Norte, Nueva Vizcaya.

Methods

This study utilized an action research design with a mixed-method approach, specifically a sequential explanatory design, to enhance mastery and motivation levels of Grade 12 learners in Earth and Life Science through gamified e-learning applications. Quantitative methods measured motivation, mastery levels, and their relationships, while qualitative research explored students' experiences through thematic and coding analysis. Since Bugkalot High School's Grade 12 had only one section, a pre-experimental one-group pretest-posttest design was implemented, allowing for complete enumeration of participants at a single time point.

Results and Discussion

Mastery Level of Grade 12 Learners before and after the implementation of Gamified E-Learning Applications

Table 1. Mean Percent Scores (MPS) of the Mastery Level of Grade 12 Learners before and after the implementation of Gamified E-Learning Applications

Least Mastered Competencies (LMCs)	Pretest		Posttest	
	MPS	**QD**	**MPS**	**QD**
Recognize the uniqueness of Earth, being the only planet in the solar system with properties necessary to support life (S11/12ES-Ia-e-3)	57	NM	83.5	M
Explain that the Earth consists of four subsystems, across whose boundaries matter and energy flow (S11/12ES-Ia-e-4)	26.5	NM	73	AM
Identify common rock-forming minerals using their physical and chemical properties (S11/12ES-Ia-9)	26.5	NM	86.5	M
Compare and contrast the formation of the different types of igneous rocks (S11/12ES-Ic-18).	36.5	NM	77.5	AM
Total	**36.63**	**NM**	**80.13**	**M**

Legend: 0-59.99 (NM-No Mastery), 60 – 69.99 (LM-Low Mastery), 70-79.99 (PM-Partial Mastery), 80-89.99 (ME-Meets Expectation), 90-100(A-Advanced)

Participants' mastery levels in Earth and Life Science improved significantly from the pretest (MPS=36.63) to the posttest (MPS=80.13). Initially, there was no mastery, but posttest results showed mastery in competencies like S11/12ES-Ia-e-

3 (MPS=83.5) and S11/12ES-Ia-9 (MPS=86.5), and average mastery in S11/12ES-Ia-e-4 (MPS=73) and S11/12ES-Ic-18 (MPS=77.5). This suggested that gamified e-learning applications enhance mastery levels. These findings were consistent with Caballero et al. (2022) and Tolentino et al. (2019), who also reported that gamification improves academic performance and student achievement.

Table 2. Frequency and Percentage of the Grade 12 Learners' Mastery Level before and after the implementation of Gamified E-Learning Applications

MPS	Level	Pre-Test		Post-Test	
		f	%	f	%
90-100%	Advanced	0	0	0	0
80 – 89.99%	Meets Expectation	0	0	5	25
70 – 79.99%	Partial Mastery	1	5	15	75
60 – 69.99%	Low Mastery	2	10	0	0
0 – 59.99%	No Mastery	17	85	0	0
Total		**20**	**100**	**20**	**100**

Out of 20 participants, 85% had no mastery before using gamified e-learning applications, but after the post-test, 75% achieved partial mastery. This significant improvement aligns with studies by Caballero et al. (2022) and Tolentino et al. (2019), indicating that gamified applications positively impact academic success.

Table 3. ***Mean Percent Scores (MPS) of the Mastery Level of Grade 12 Learners on the implementation of Gamified E-Learning Applications***

	Title of Activities	No. of Items	MPS	QD
1.	Origin and Structure of the Earth *(Jcross: Pinoy Henyo)*	10	83.5	M
2.	Recognize the Uniqueness of the Earth *(Jquiz:Game ka na ba?)*	10	75.5	AM
3.	Hydrosphere *(Jmix: Family Feud)*	7	78.57	AM
4.	We are all Connected *(J:closePinoy Henyo)*	10	95.5	M
5.	The Subsystem *(Jquiz:Game ka na ba?)*	15	84.33	M
6.	Properties of Minerals *(Jcross: Pinoy Henyo)*	10	92	M
7.	Mohs Scale of Hardness *(Jmix: Family Feud)*	10	71	AM
8.	Minerals *(Jquiz:Game ka na ba?)*	15	81.66	M
9.	Igneous Rocks: How Are They Formed? *(JMatch:Pares Pares)*	10	70.5	AM
10.	Igneous Rock *(Jquiz:Game ka na ba?)*	15	85.33	M
	Overall Mean		**81.79**	**M**

Legend: 0-59.99 (NM-No Mastery), 60 – 69.99 (LM-Low Mastery), 70-79.99 (PM-Partial Mastery), 80-89.99 (ME-Meets Expectation), 90-100(A-Advanced)

On average, participants achieved a mastered level (MPS=81.79) after completing all gamified activities. Specifically, they mastered activities 1, 4, 5, 6, 8, and 10, while achieving an average mastery level for the remaining activities. This demonstrated effective learning using the gamified e-learning application as an intervention. These results were consistent with studies by Caballero et al. (2022) and Tolentino et al. (2019), which showed that gamified instruction significantly enhances student mastery levels.

Motivation Level of Grade 12 Learners before and after the implementation of Gamified E-Learning Applications

Table 4. Mean of the Motivation Level of Grade 12 Learners before and after the implementation of Gamified E-Learning Applications

	Statements	Pre-Motivation		Post-Motivation	
		Mean	**QD**	**Mean**	**QD**
1.	I find studying more interesting.	3.15	MM	4.35	HM
2.	I use a variety of methods that ensure thorough understanding.	3.4	M	4.3	HM
3.	I learn with great interest and put in adequate effort	3.65	M	4.35	HM
4.	I expect to achieve better in my core, applied and specialized subjects than before.	3.4	M	4.3	HM
5.	I try to perform well in my subject compared to before.	3.8	M	4.55	HM
6.	It makes me anxious about how I will perform in my modular learning.	2.4	SM	4.2	M
7.	It is essential and valuable for me.	3.6	M	4.4	HM
8.	I take learning seriously about my performance and how it will influence my overall grade.	3.9	M	4.55	HM
9.	I'm challenged to employ the learning I've gained in daily lives and in future.	3.6	M	4.25	HM
10.	I more personally responsible in my studies	3.3	MM	4.35	HM
11.	I am more accountable to create positive environment of learning	3.05	MM	4.35	HM
12.	I am sure to perform better in written works and performances.	2.75	MM	4.2	M
13.	I am confident in my abilities to answer the activity sheets in my modules.	3.7	M	4.5	HM
14.	My capabilities and competencies are boosted more.	3.5	M	4.4	HM
15.	I am positive that I can achieve a 'Very Satisfactory to Outstanding' grade.	2.45	SM	3.95	HM
16.	I'm more enthusiastic about learning the lessons.	3.1	MM	4.35	HM
17.	Learning has realistic worth for me.	4.3	HM	4.45	HM
18.	Learning is associated or pertinent to my existence	3.2	MM	4.2	M
19.	I learn to behave well as a student.	3.85	M	4.5	HM
20.	I'm motivated to submit my module on time.	3.3	MM	4.1	M
21.	I'm motivated to explore more learnings.	3.3	MM	4.45	HM
22.	I'm driven with focus-oriented goals in my education.	2.95	MM	4.6	HM
23.	I'm interested in helping my classmates in his/her module.	3.05	MM	4.15	M
24.	I'd like to share what I've learned with others.	3.85	M	4.65	HM
	Over-all Motivation Level	**3.36**	**MM**	**4.35**	**HM**

Legend: 1-1.80 (NM-Not Motivated), 1.81-2.60 (SM-Slightly Motivated), 2.61-3.40 (MM-Moderately Motivated), 3.41-4.20 (M-Motivated), 4.21-5.0 (HM-Highly Motivated)

Participants' motivation levels significantly improved from pre-intervention (Mean=3.36), categorized as moderately motivated, to post-intervention (Mean=4.35), categorized as highly motivated. This demonstrated an overall enhancement in motivation levels from moderate to high following the implementation of gamified e-learning applications. These findings are in line with Hursen and Bas (2019), who observed that gamified applications positively impact students' motivation in science education.

Difference Between the Mastery Level of the Learners Before and After the Utilization of the Intervention

Table 5. Paired sample t-test comparing the mastery level of the learners before and after the utilization of the intervention

Variable	MPS	SD	T stat	Df	Sig. (2-tailed)	Effect Size
Pre-Test	46.37	23.20	-11.03	19	0.000**	Large
Post-Test	76.12	4.15				

**Significant at 0.01 level of significance.

The pre-test scores (MPS=46.37, SD=23.20) and post-test scores (MPS=76.12, SD=4.15) indicated a significant difference (t=-11.03, p=0.000<0.01), with post-test scores showing a notable improvement over pre-test scores using gamified e-learning applications, accompanied by a large effect size. These results align with Cajilla & Bug-os (2022), who reported increased academic achievement in physical science through gamified learning management.

Difference Between the Motivation Level of the Learners Before and After the Utilization of the Intervention

Table 6. Paired sample t-test comparing the motivation level of the learners before and after the utilization of the intervention

Variable	MPS	SD	T stat	Df	Sig. (2-tailed)	Effect Size
Pre-Motivation	67.4	0.22	-11.17	19	0.000*	Large
Post-Motivation	87.15	0.38				

**Significant at 0.01 level of significance.

There was a significant difference (t=-11.17, p=0.000<0.05) between the pre- and post-motivation MPS, with the post-motivation MPS higher than the pre-motivation MPS. This indicated a substantial improvement in motivation levels using gamified e-learning applications, with a large effect size observed. These findings are consistent with studies by Caballero et al. (2022), Cajilla and Bug-os (2022), Samonte et al. (2019), and Malahito and Quimbo (2020), all of which highlighted the positive impact of gamified e-learning applications on increasing students' motivation levels.

Students' Evaluation on the Gamified E-Learning Application in Earth and Life Science

Participants reported varying levels of enjoyment and comfort with the gamified learning activities, reflecting different preferences and comfort levels across topics. They also faced challenges, including comprehension difficulties, trouble answering questions, limited vocabulary, and pronunciation issues. Despite these challenges, participants recognized the benefits of gamified e-learning, such as enhanced understanding, vocabulary, reading skills, and learning from mistakes. They reported increased engagement, skill development, and a positive impact of technology on learning outcomes. Overall, feedback was positive, highlighting benefits like improved reading and analytical skills and the effective integration of technology in learning. These findings support Jawad and Tout (2021), who also observed significant benefits from gamification in education.

Conclusions and Recommendations

In conclusion, the study demonstrated that learners significantly increased their mastery level from no mastery to average mastery when using gamified e-learning applications, indicating their effectiveness in enhancing learning outcomes. Motivation levels notably improved from moderate to high, highlighting the positive impact of gamified approaches on learner engagement. Learners expressed positive perceptions of the support provided by these applications, noting improvements in vocabulary, knowledge retention, and learning skills through interactive features like hints and corrective feedback.

It is strongly recommended to integrate gamified e-learning applications across all disciplines to facilitate efficient and effective learning. Teachers should leverage various gamified learning platforms to enhance motivation and cultivate

essential 21st-century skills. Given the prevalent use of digital platforms in education, creativity in technology integration is essential, along with localization and indigenization of educational content to cater to learners' needs. Educational institutions should prioritize digital literacy by providing necessary devices for gaming activities and offering training and seminars to educators on effective gamified e-learning implementation. This approach can empower teachers to maximize the benefits of gamification in their teaching practices.

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LEVEL OF PERFORMANCE IN MATHEMATICS AND SOCIAL SKILLS OF JUNIOR HIGH SCHOOL LEARNERS UTILIZING PROJECT SMART

EDISON B. LOPEZ
Teacher III
Bonfal National High School

DOLORES A. SANTOS
Teacher III
Bonfal National High School

Abstract

The study analyzed the effect of Project SMART, a peer-tutoring technique, on students' Math performance and social skills. Two sections each of Grade 8 and 9 from a public high school in Nueva Vizcaya participated. Using a quasi-experimental design, participants were divided into experimental and control groups. Descriptive-quantitative methods assessed the Math performance and social skills before and after the intervention. Descriptive-comparative methods evaluated the intervention's impact, while descriptive-correlational methods explored the link between Math performance and social skills. Thematic analysis examined participants' suggestions. The findings showed significant improvements in both performance and social skills, with Project SMART outperforming traditional methods. A positive correlation was found between social skills and Math performance. Recommendations include monitoring progress, sustaining improvements, ongoing social skills initiatives, promoting implementation, supporting struggling students, and establishing feedback mechanisms.

Keywords: *Improved learning, numeracy, peer tutorial, social constructivism, teaching strategies*

Introduction

Society considers mathematics essential for scientific and technological knowledge, crucial for a country's progress, with proficiency defined by five strands: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and creative disposition (Lillian, Gilbert & Samson, 2020; Collins, 2011). To improve such, the Philippine government through the Department of Education implemented the Enhanced Basic Education Act of 2013 (RA 10533). However, during its implementation, COVID-19 hit the world causing a massive impact in the education sector. With this, the Department of Education (DepEd) through Secretary Leonor Magtolis Briones responded by introducing the Basic Education Learning Continuity Plan (BE-LCP).

Despite significant efforts, many issues emerged post-pandemic. Berse (2022) noted that prolonged remote learning caused students to lose key numeracy and reading skills. UNICEF reported a 17% increase in learning losses in low- and middle-income countries due to school closures (Pajayon-Berse, 2022). In response, Vice President and DepEd Secretary Sara Z. Duterte launched MATATAG: Bansang Makabata, Batang Makabansa in 2023 to address education challenges. Regarding the "TA" aspect (TAke good care of learners by promoting well-being, inclusive education, and a positive learning environment), parents reported significant negative impacts on learners' social skills due to spending most of their time indoors (Hernández & Jabbari, 2022). Social skills, crucial for communication, suffered as children lacked regular interactions (Campbell, 2021). To address this, peer tutoring is suggested. This method, where students act as both tutors and learners, promotes social and intellectual growth, increases task engagement, and boosts confidence

and self-efficacy (Hott, Walker & Sahni, 2012). Additionally, teaching others enhances knowledge retention by 90% (Colman, 2022).

In line with the agenda MATATAG and the benefits of peer tutoring, Mathematics teachers at Bonfal National High School initiated to conduct project SMART (Strengthening Mathematical Abilities to Recognized Targets), an intervention to address low performing students in Math and develop their social skills in a form of peer-tutoring. This strategy is anchored to Social Constructivism. This theory says that language and culture serve as the framework through which people experience, communicate, and perceive reality (Akpan, Igwe, Mpamah, & Okoro, 2020).

Objectives of the Study

The study investigated the effect of Project SMART on the performance and social skills of Grade 8 and 9 learners. Specifically, it determined the levels of performance and social skills of the control and experimental groups before and after Project SMART, determined the difference in the levels of performance and social skills between the control and experimental groups before and after Project SMART, determined the difference in levels of performance and social skills gain scores between the control and experimental groups, determined the relationship between participants' performance levels and social skills levels; and proposed potential enhancements to the intervention.

Methods

The study involved Grade 8 and 9 students from Bonfal National High School (2023-2024). Using a quasi-experimental pre-posttest design, participants were divided into experimental and control groups. The study used a mixed-method approach, employing descriptive-quantitative methods to assess performance and social skills before and after the intervention. Performance was measured with validated achievement tests (α=0.72 and Aiken's V=0.87 for Grade 8, α=0.77 and Aiken's V=0.88 for Grade 9), and social skills were assessed with the Social Skills Rating System (α=0.90). T-tests determined the intervention's effect, while Spearman explored the association between performance and social skills. Thematic analysis was used to analyze suggestions for improvement.

Results and Discussion

Performance Level of the Control and Experimental Group in Mathematics Before and After the Conduct of Project SMART

Table 1. Mean Percentage Scores (MPS) of the Control and Experimental Group in Mathematics

Grade Level	Administered Test	Control Group			Experimental Group		
		MPS	SD	Description	MPS	SD	Description
8	Pre-test	70.57	1.36	DNME	70.43	1.36	DNME
	Post-test	82.22	6.78	S	85.22	6.12	VS
9	Pre-test	70.67	1.81	DNME	71.28	2.16	DNME
	Post-test	81.77	2.82	S	84.67	3.90	VS

Legend: Below 75 (DNME-Did Not Meet Expectations), 80-84 (S-Satisfactory), 85-89 (VS-Very Satisfactory)

Before the intervention, Grade 8 and 9 students in both control and experimental groups were at the DNME level. After the intervention, significant improvements were observed in both groups, with performance levels rising to S and

VS, respectively. These results aligned with Silangan (2023), showing that the average performance of participants reached satisfactory levels.

Social Skills Level of the Control and Experimental Group Before and After the Conduct of Project SMART

Table 2. Mean of the Control and Experimental Group in SRSS before and after Project SMART

Dimensions	Before the Intervention						After the Intervention					
	Control Group			Experimental Group			Control Group			Experimental Group		
	M	SD	Desc.	M	SD	Desc.	M	SD	Desc.	M	SD	Desc.
						Grade 8						
Self-Control	2.63	0.08	Moderate	2.63	0.10	Moderate	3.13	0.20	Moderate	3.55	0.16	High
Empathy	2.73	0.07	Moderate	2.62	0.06	Moderate	3.34	0.16	Moderate	3.64	0.13	High
Assertion	2.72	0.08	Moderate	2.59	0.04	Moderate	3.08	0.17	Moderate	3.53	0.08	High
Cooperation	2.64	0.07	Moderate	2.65	0.08	Moderate	3.20	0.23	Moderate	3.43	0.17	Moderate
Overall MEAN	**2.74**	**0.61**	**Moderate**	**2.76**	**0.64**	**Moderate**	**3.17**	**0.38**	**Moderate**	**3.65**	**0.48**	**High**
						Grade 9						
Self-Control	2.50	0.05	Moderate	2.57	0.05	Moderate	3.16	0.31	Moderate	3.46	0.18	Moderate
Empathy	2.57	0.08	Moderate	2.57	0.08	Moderate	3.23	0.35	Moderate	3.70	0.08	High
Assertion	2.62	0.09	Moderate	2.55	0.07	Moderate	3.01	0.38	Moderate	3.60	0.10	High
Cooperation	2.61	0.06	Moderate	2.65	0.09	Moderate	3.19	0.21	Moderate	3.55	0.25	High
Overall MEAN	**2.60**	**0.58**	**Moderate**	**3.02**	**0.15**	**Moderate**	**2.61**	**0.54**	**Moderate**	**3.80**	**0.40**	**High**

Legend: 2.50-3.49 (Moderate), 3.50-4.00 (High)

Both the control and experimental groups of Grade 8 and 9 students had moderate social skills across four dimensions before and after the intervention. Their social skills improved from moderate to high levels after the intervention. Paroginog, Dusal-Alpuerto, and Pilongo (2018) found similar moderate levels of social skills in their study.

Difference on the Performance Level of the Control and Experimental Group Before and After the Conduct of Project SMART

Table 3. Paired sample t-test result in comparing the pretest and posttest results of the control and experimental group

Grade Level	Administered Test	Mean	SD	T	Df	Sig (2-tailed)	Effect Size	Description
Control Group								
8	Pre-test	70.57	1.36	-12.337	45	.000	0.77	Moderate
	Post-test	82.22	6.78					
9	Pre-test	70.67	1.81	-35.572	42	.000	0.97	Large
	Post-test	81.77	2.82					
Experimental Group								
8	Pre-test	70.43	1.36	-17.344	45	.000	0.87	Large
	Post-test	85.22	6.12					
9	Pre-test	71.28	2.16	-30.893	45	.000	0.95	Large
	Post-test	84.67	3.90					

There was a significant increase in Mean Percentage Score (MPS) from pretest to posttest in both Grades 8 and 9 control and experimental groups, indicating improved performance levels. The effect sizes suggest moderate to large improvements in performance for Grade 8 and 9 control groups, and consistently large improvements for experimental groups. These findings support Kumar's (2023) assertion that innovative teaching strategies enhance learning outcomes, creativity, communication, decision-making, flexibility, and motivation.

Difference On the Social Skills Level of the Control and Experimental Group Before and After the Conduct of Project SMART

Table 4. Paired sample t-test result in comparing the social skills level of the control group

Grade Level	Administered Test	Mean	SD	T	Df	Sig (2-tailed)	Effect Size	Description
Control Group								
8	BI	2.74	.61	-3.786	45	.000	0.24	Small
	AI	3.17	.38					
9	BI	2.60	.58	-5.039	42	.000	0.38	Small
	AI	3.02	.15					
Experimental Group								
8	BI	2.77	.64	-8.200	45	.000	0.60	Moderate
	AI	3.65	.48					
9	BI	2.61	.54	-13.102	45	.000	0.79	Moderate
	AI	3.80	.40					

Legend: BI – Before Intervention; AI – After Intervention

A significant difference was observed between the control groups' social skills levels before and after the intervention among participants in grades 8 and 9, both in the control and experimental groups. This suggests that participants generally demonstrated a higher level of social skills before the intervention compared to after its conduct, signifying an improvement in their social skills levels. However, the effect on social skills for the control groups was small, while for the experimental groups, the effect was moderate, as indicated by the effect sizes. These findings align with previous studies exploring the impact of various teaching strategies on social skills (Hidayat et al., 2023; Karningsih, 2021).

Difference Between the Gain Scores of the Performance Level of the Control and Experimental Group

Table 5. Independent samples t-test result in comparing the gain scores of the performance level of the control and experimental group

Grade Level	Administered Test	Mean	SD	t	Df	Sig (2-tailed)	Effect Size	Description
8	Control Group	11.65	6.41	-2.461	90	.016	0.06	Small
	Experimental Group	14.78	5.78					
9	Control Group	11.09	2.04	-4.304	80.523	.000	0.18	Small
	Experimental Group	13.39	2.94					

A significant difference in the gain scores between the control and experimental groups for both grades 8 and 9 was shown. Both groups in both grade levels showed improvement, but there was a greater enhancement in the experimental groups compared to the control groups. This suggests that the intervention was more effective in fostering improvement compared to the usual teaching method. However, these differences were just minor. This data aligns with the findings of various studies (Ahmad & Mohamed, 2018; Ullah, Tabassum, & Kaleem, 2018; Marieswari & Prema, 2016), which concluded that peer tutoring significantly enhanced the academic achievement of students compared to their control variables.

Difference Between the Gain Scores of the Social Skills Level of The Control and Experimental Group

Table 6. Independent samples t-test result in comparing the gain scores of the social skills level of the control and experimental group

Grade Level	Pretest	Means	SD	t	Df	Sig (2-tailed)	Effect Size	Description
8	Control Group	.43	.78	-2.887	90	.005	0.09	Small
	Experimental Group	.89	.74					
9	Control Group	.42	.54	-6.269	87	.000	0.31	Small
	Experimental Group	1.20	.62					

A significant difference in the gain scores between the control and experimental groups for both grades 8 and 9 was noted. Both groups in both grade levels showed improvement, but the data indicate a greater enhancement in the experimental groups compared to the control groups. This suggests that the intervention had a positive effect on their level of social skills. Yet, these differences were just minor as shown by the effect sizes. These results echo the findings of Mellado, Valdebenito, and Aravena (2017), who stated that students participating in the peer tutoring program exhibited a statistically significant increase in their development of social skills compared to the control group.

Relationship Between the Mean Percentage Score (MPS) and Level of Social Skills of the Learners under Project SMART

Table 7. Spearman's rho result in determining the relationship between MPS and social skills level

	Spearman's rho	Strength of Relationship	p-value	Decision	Remarks
Mean Percentage Score vs. Social Skills Level	.634**	Strong relationship	.000	Reject Ho	Significant

A strong relationship between MPS and social skills level was noted indicating that as the MPS increases, the level of social skills also tends to increase. Bartholomeu, Montiel, Néia, and Rocha Silva (2016) corroborated these findings, confirming that higher levels of social skills were positively associated with good academic performance in Mathematics.

Suggestions for Project SMART Enhancement

During interviews, teachers noted challenges such as time constraints, limited space, and inadequate resources. Suggestions included flexible scheduling, utilizing alternative spaces, and integrating digital tools. Teachers recommended setting clear behavioral expectations, using interactive strategies for motivation, and providing ongoing support for tutors. Tutors faced challenges with bossy or inattentive tutees; suggestions included effective communication, fostering a supportive environment, and encouraging shy tutees to participate. Addressing misbehavior involved promoting an open environment for questions and supporting shy students in active learning engagement.

Conclusions and Recommendations

Based on the study's findings, participants showed significant improvements in academic performance and social skills through implemented strategies. Progress from Did Not Meet Expectations (DNME) to levels like Satisfactory (S) and Very

Satisfactory (VS) highlights the interventions' effectiveness. Project SMART proved more effective than traditional methods, demonstrating substantial gains in both areas. Additionally, a positive correlation was found between participants' academic performance (Mean Percentage Score, MPS) and their social skills. Insights from participant feedback offer valuable suggestions for overcoming implementation challenges and ensuring ongoing success in future interventions

Based on these conclusions, several recommendations are advised: monitor progress, support struggling students, and maintain satisfactory or higher performance levels through ongoing evaluation and assistance. Implement additional teaching strategies to enhance students' social skills levels, explore diverse methods to sustain learning improvements, and adapt strategies to meet varied student needs effectively. Provide ongoing social skills initiatives for all students to foster improved social interactions. Advocate for Project SMART among educators, promote its implementation, and support educators in integrating it effectively. Offer support for students with lower Mean Percentage Scores (MPS) to enhance social skills and academic success. Establish feedback mechanisms for continuous improvement, collaboratively address challenges, and ensure interventions meet student needs for ongoing enhancement.

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MERRIAM-WEBSTER DICTIONARY APPLICATION: ITS EFFECTIVENES IN IMPROVING G12 PERFORMANCE IN CREATIVE WRITING

JAYSON S. DELOS SANTOS
Teacher III
Bintawan National High School

Abstract

In response to recent education challenges in the Philippines, addressing the comprehension problems of learners was crucial, particularly in improving their performance in one of the least mastered competencies: Creative Writing. This study employed an intervention, the Merriam-Webster Digital Dictionary Application. A pre-test and post-test were administered to a group of 40 respondents. During the intervention, participants were guided in using the digital dictionary. Through thorough data analysis and procedures, the study demonstrated significant differences between their initial and final scores. Furthermore, most of the learners progressed from Little Mastery to Mastery Level, and they enjoyed and understood the reading selection as evidenced during the study. Qualitative data also indicated that the intervention helped them comprehend the reading selection. The implications of these results are further discussed, emphasizing their significance for language teaching.

Keywords: Dictionary application, contextualized learning material, mastery level

Introduction

DepEd launched MATATAG in January 2023 to tackle educational challenges through a holistic approach. MATATAG focuses on: (1) Making the curriculum job-relevant and fostering citizenship; (2) Accelerating educational service delivery and facilities provision; (3) Promoting learner well-being and inclusive education; and (4) Supporting teachers for effective teaching. This initiative aims to enhance the Philippine education system amidst global assessments like PISA 2018, where the country ranked low in reading, math, and science literacy. TIMSS 2019 also showed poor results in math and science proficiency. These findings highlight the need for improvements in curriculum relevance and teaching strategies to elevate educational outcomes nationwide.

Diction, crucial in communication, is a primary focus in Senior High School Creative Writing, shaping effective language use. Enriching vocabulary is vital for academic success, as noted by Boulton and Cook (2017), especially for non-native speakers facing language challenges in higher education.

Senior high school learners face challenges in expressing ideas due to limited vocabulary, affecting both written and oral communication. This gap, exacerbated by a lack of reading culture and comprehension, contrasts sharply with academic demands. Intervention strategies, including re-reading and game-based learning, aim to bridge these gaps by enhancing vocabulary acquisition and language fluency. Educators emphasize the importance of resources like the Merriam Webster Dictionary to support language learning and improve academic performance across subjects.

Objectives of the Study

This action research investigated G12 learners' performance in evoking responses, comparing before and after using the Merriam Webster Dictionary App, and explored their experiences and suggested enhancements for its use in Creative Writing.

Methods

Descriptive - qualitative research at BNHS explored Grade 12 students' experiences with the Merriam Webster Dictionary App, assessing learning competencies in Creative Writing through pre-tests, post-tests, and guided interviews.

Results and Discussion

Mastery level of G12 Learners before and after the intervention

Table 1. Performance Levels of G12 Learners Before and After the Intervention

	Mean Score	SD	Description
Pre-Test	34.1	4.109	Very little mastery
Post-Test	71.31	3.831	Partial Mastery

Learning Competency: *Utilizing language in evoking emotional and intellectual responses from readers (HUMSS _CW/MP11/12-Iab-3)*

Participants scored consistently low in the Pre-Test (M=34.1, SD=4.109). This implies that there is a problem in understanding what they read. It is noteworthy to mention that the comprehension text contains the famous short story, Guy de Maupassant's The Necklace. This suggests that learners have difficulties reading the text with comprehension. On the other hand, the post-test scores (M=71.31, SD=3.831) were comparatively higher than the pre-test scores, indicating a partial mastery level. This may suggest that the respondents have utilized language more in evoking emotional and intellectual responses after the intervention was conducted.

Difference between the G12 learners' performance in Creative Writing before and after the utilization of the Merriam-Webster Digital Dictionary Application

Table 2. Significant Difference in the mastery level before and after the intervention

Indicator	Mean	SD	t	df	Sig. (2-tailed)
Before	17.7	4.109	-11.81	39	0.000
After	25.125	3.831			

There was a significant difference between the pre-test and post-test (t=-11.8, p=0.000<0.05), indicating that the performance of the 12 HUMSS students improved after the intervention. This further suggests that using a digital dictionary application to aid in word comprehension could be an effective strategy for enhancing learners' academic achievement.

Manuel (2022) suggested that ESL teachers should continue exploring creative methods for teaching reading comprehension to assist English learners, while Thornbury (2002) argued that language comprehension and production can be hindered by vocabulary limitations. Therefore, the use of the Merriam-Webster

Digital Dictionary App represents a creative solution to challenges faced by English teachers, as it enhances both comprehension and production.

Significant experiences of the G12 learners in utilizing the Merriam-Webster Digital Dictionary Application.

A thematic analysis was conducted to identify themes in the responses of Grade 12 HUMSS learners regarding their use of the Merriam-Webster Digital Dictionary App. After analyzing the gathered qualitative data, emerging themes discussed by respondents included the vocabulary words learned, the difficulty of the text, and how the Merriam-Webster app aided comprehension.

Conclusions and Recommendations

The findings indicated that the Merriam-Webster Digital Dictionary Application effectively raised learners' mastery levels from Very Little Mastery to Mastery. Participants showed a substantial improvement in knowledge, as reflected in their higher post-test scores. Overall, learners reported positive experiences with the intervention.

Based on these conclusions, the following recommendations were made: integrate the Merriam-Webster Digital Dictionary Application into English language lessons; use it consistently to improve learner performance; encourage its use among students facing challenges with comprehension; highlight its benefits in Learning Action Cell (LAC) sessions; and incorporate vocabulary acquisition strategies into language teachers' LAC discussions. These actions aim to maximize the dictionary app's effectiveness in enhancing language learning outcomes.

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PROBLEM-SOLVING ABILITY AND INTEREST LEVEL OF GRADE 10 LEARNERS IN THE UTILIZATION OF VAKT (VISUAL, AUDITORY, KINESTHETIC & TACTILE) LEARNING STYLE MODEL IN GAS LAWS

ROEL C. BOSE
Teacher III
Casat National High School

Abstract

This study focused on investigating the effect of VAKT Learning Style with Lecture & Drill Method compared to Pure Lecture and Drill Method on the Problem-Solving Ability of Grade 10 Learners. It utilized VAKT Learning Style Inventory Checklist, 50-Item Multiple Choice and Interest Level Survey Form among 46 Grade 10 learners in which 6 learners were classified under the control group and the other 40 were classed under the experimental group. The findings revealed that the level of problem-solving ability for both the control (Pure Lecture and Drill Method) and experimental group (VAKT Learning Style Model and Lecture & Drill Method) for both the pretest and posttest was classified as "Least Mastered". However, there was a significant increase in the level of problem-ability in the experimental group as compared to the control group. The gain score for the experimental group was significantly higher than with the control group. Aside from that, the interest level was found significantly higher in the experimental group than in the control group. The result from this study can be used to support the basis for including learning style such VAKT Learning style model to be included as an arsenal for teachers in 21st Century Education.

Keywords: Arsenal, action-research, gain score, quasi-experimental

Introduction

Chemistry is the foundation of science, technology, and industry (Magdara, D., 2015) and plays a pivotal role in national development, as technologically advanced countries are often viewed as more progressive. However, Chemistry is one of the most challenging subjects to learn due to its abstract concepts and mathematical components. These challenges are emphasized in the 2019 Trends in International Mathematics and Science Study (TIMSS), where the Philippines ranked among the lowest in Science and Mathematics Education globally. Bondoc (2016) noted that the abstract nature of many science topics requires concrete visualization to aid student understanding, particularly in problem-solving.

To address these challenges, the VAKT (Visual, Auditory, Kinesthetic, and Tactile) Model was developed to cater to various learning styles. In this model, learners are classified based on their preferred learning styles, which are then matched with specific activities to enhance learning. VAKT Model activities promote active learning, which helps reduce misconceptions and strengthens conceptual understanding.

Other multi-sensory teaching approaches, such as Gardner's Multiple Intelligences, Differentiated Instruction, and Dunn & Dunn Learning Styles, are also gaining popularity. Odicta (2017) found that differentiated instruction positively impacted students' mathematics achievement and critical thinking skills.

The topic of Gas Laws in Grade 10 Chemistry, which deals with the behavior of gases under various conditions, is known for its abstract concepts and mathematical problem-solving challenges. The MELC code for this topic is S9MT-IIj-20, and it is typically covered during the first two weeks of the 4th Quarter, focusing on Boyle's Law, Charles's Law, and the Kinetic Molecular Theory. Gas Laws are often considered one of the least mastered topics in the classroom.

This study explores the potential integration of the VAKT Model with the Lecture and Drill method for teaching Gas Laws. It evaluates the effectiveness of this integrated approach compared to the traditional Lecture and Drill method, using activities tailored to each group's learning style.

Objectives of the Study

This study focused on investigating the effect of VAKT Learning Styles on the development of problem-solving abilities in students. Specifically, the study aimed to: (1) assess the problem-solving ability of Grade 10 learners on Gas Laws, (2) compare the pre-test and post-test scores of both the control and experimental groups, (3) determine if the gain scores of both groups differ significantly, (4) evaluate the interest level of students after the interventions in both groups, and (5) compare if the interest levels of both groups are significantly different.

Methods

This study employed a combination of an action-research approach and a quasi-experimental approach. Two groups were identified: the control group (N=6) and the experimental group (N=40), based on a VAKT Learning Style Survey Form. To compare the significant difference in the gain scores and interest levels between the two groups, the Mann-Whitney U Test was used, with a significance level of 0.05. For characterizing the interest level of each group, quantitative values were assigned to the students' responses. The mean and standard deviation were computed based on these responses, and the mean was assigned a qualitative description.

Results and Discussion

Table 1. Problem-Solving Ability of Grade 10 (Control and Experimental) Learners in the Pre-Test and Posttest

Learning Competency Code	Group	Pre-Test		Posttest	
		MPS	QD	MPS	QD
S9MT-IIj-20	Control	30.33 %	Beginning	34.66 %	Beginning
	Experimental	34.05 %	Beginning	57.70 %	Beginning

Legend: *0-59.99 % = Beginning, 60-69.99 %= Developing Proficiency, 70-79.99 %= Approaching Proficiency, 80-89.99 %= Proficient, 90-100 %= Advanced*

The control group was subjected to the Lecture & Drill Method of teaching which the MPS for both the pretest (MPS=30.33 %) and post-test (MPS=34.66 %) were categorized as "Beginning". It was observed that there was a slight increase in the MPS for the post-test when compared with the MPS for the pre-test.

The performance level of Grade 10 learners in the experimental group in the pretest and post-test showed that VAKT Learning Style Model Activities reinforced with the Lecture & Drill Method of teaching. The MPS for both the pretest (MPS=34.05 %) and post-test (MPS= 57.70 %) were categorized as "Beginning". However, there was a higher increase in the MPS for the pretest and post-test scores

of the students exposed to the VAKT Learning Style and Lecture and Drill Method as compared with the students exposed to pure Lecture and Drill Method only. This can be attributed that most teachers were using only Lecture and Drill Methods and very few focused on delivering lessons concerning the student's learning styles.

Table 2: Difference in the Pretest and Posttest of Grade 10 Learners (Control & Experimental)

Groups		MPS	SD	df	t-critical	p-value	Effect Size
Experimental (VAKT Learning Style Model and Lecture & Drill Method)	Before	34.06	5.14	39	-10.202	< 0.001	0.73
	After	57.70	10.35				
Control (Lecture and Drill Method)	Before	30.33	4.02	5	-0.625	0.560	0.07
	After	44.00	5.47				

Significant Level: 0.05

Results from the pretest and posttest result yielded a posttest MPS of 44.00, which was not significantly higher than the pretest MPS of 30.33, as supported by the p-value (0.560) which exceeds the 0.05 level of significance. In contrast, the experimental group's posttest MPS of 57.70 was significantly higher than its pretest MPS of 34.06, with a p-value of 0.001, which is below the 0.05 level of significance.

It was implied from the findings that the increase in the MPS for the experimental group was significantly affected by the utilization of the VAKT Learning Style model with the Lecture & Drill Method and pure Lecture and Drill Method will not be able to do the job. This was consistent with the findings of Salomon and Ramo (2016), that differentiation in instruction, such as the use of the VAKT Learning Style Model, was more effective in traditional approaches of learning like pure lecture and drill method. Teaching will be more effective if teachers learn to differentiate the instructional process.

Table 3: Independent Samples Mann-Whitney U Test on the Gain Score of Grade 10 Learners

Groups	Mean Rank	Mann Whitney U	Asymptotic Significance
Experimental (N= 40) (VAKT Learning Style Model and Lecture and Drill Method)	25.18	53.00	0.027
Control (N= 6) (Lecture and Drill Method)	12.33		

Significant Level: 0.05

The mean rank of the experimental group (25.18) was significantly higher than the mean rank of the control group (12.33) since its asymptotic value (0.027) was lower than the 0.05 level of significance. Findings from the study found similarity from the findings of Odicta (2017) who claimed that differentiated instruction is more effective as compared with the traditional approach of teaching such as the lecture method.

Table 4 Interest Levels of Both Control and Experimental Group After the Interventions

Responses	Control			Experimental		
	Mean	SD	QD	Mean	SD	QD
1. The application of concepts learned made the lesson more interesting.	3.50	0.84	High	4.35	0.58	Very High
2. The mathematical computation part of the topic is interesting because it is very easy to understand.	3.00	0.63	Moderate	3.18	1.01	High
3. The topic becomes more interesting because we have fun while learning.	3.83	0.75	High	4.18	0.64	Very High
4. The learning materials used made the lesson more interesting.	4.00	0.89	High	4.10	0.59	Very High

Responses	Control			Experimental		
	Mean	SD	QD	Mean	SD	QD
5. Group and individual activities made the topic more interesting.	3.17	0.75	High	4.15	0.62	Very High
6. Activity sheets are more interesting because the words used are very simple and easy to understand.	3.50	0.84	High	3.70	0.79	High
7. The experiments and activities that were carried out were very interesting and enjoyable.	3.50	1.04	High	4.03	0.73	Very High
8. The presentation of our output is very interesting because we are allowed to be creative.	3.83	0.75	High	4.03	0.48	Very High
9. Learning materials have clearer directions.	3.83	0.75	High	3.95	0.64	High
10. Learning is more interesting because the teacher is more approachable	3.83	0.98	High	4.28	0.55	Very High
11. We have fun doing the activities and tasks.	3.50	0.55	High	3.83	0.81	High
12. Almost everybody is ready to participate in the activity.	3.50	0.84	High	3.65	0.80	High
Over-All	**3.58**	**0.80**	**High**	**3.95**	**0.69**	**High**

Legend: "0-1.00= Very Low, "1.01-2.00" = Low, "2.01-3.00" =Moderate, "3.01-4.00"- High, "4.01-5.00"- Very High

Out of the 12 responses that were listed, under the control group, only 11 responses were rated as "High", and only 1 response was rated as "Moderate". Under the experimental group, 7 responses were rated as "Very High", and 5 responses were rated as "High". It can also be noted that response number 2 which was rated "Moderate" by the control group focused on the mathematical computation of gas laws. While under the experimental group it was rated as "High". This implied that students under the control group were not so interested in the mathematical computation of Gas Laws. Overall, students who have undergone the utilization of the VAKT Learning Style Model and Lecture & Drill method have shown a higher overall mean of 3.95 than those who have undergone pure lecture and drill method with a mean of 3.58.

It can be assumed from the findings that those students who have been exposed to the VAKT Learning Style Model with Lecture & Drill Method have higher interest levels than those who have been exposed to pure lecture and drill methods only. Among the things that made the lesson more interesting to students in the experimental group were the applicability of the concepts learned, the presence of fun while learning, there were various learning materials, there were group & individual activities, the presence of experiments, and the approachability of the teacher. Based on these responses, it can be inferred that the teacher's strategy should vary to cater for different learners. This then also supported the claims of Odicta (2017) wherein differentiated instruction is more effective as compared with the traditional approach of teaching such as the lecture method which mostly focuses on talking, sitting while listening, and paper & pencil exercises and assessment

Table 5. Difference in the Mean Rank of the Interest Level Between the Control Group and Experimental Group

Groups	Mean Rank	Mann Whitney U	Asymptotic Significance
Experimental (N= 40) * VAKT Learning Style Model and Lecture and Drill Method	16.50	120	0.005
Control (N= 6) *Lecture and Drill	8.50		

Significant Level: 0.05

The difference in mean rank of interest level between the control and experimental groups showed asymptotic significance, in which the mean rank of the experimental group (16.50) was significantly higher than the mean rank of the control group (8.50) since its significant value was lower than the 0.05 significance level. This implied that the students in the experimental group were more interested in the lesson because the VAKT Learning Style Model was utilized in presenting different learning tasks for the topic of Gas Laws. Hence, teachers should utilize learning styles such as VAKT to increase interest among students.

Conclusions and Recommendations

The level of problem-solving ability of Grade 10 learners from both the control and experimental groups in the pretest and posttest for Gas Laws were categorized as "Least Mastered." (2) The control group (Pure Lecture and Drill Method) did not show a significant increase in problem-solving ability, while the experimental group (VAKT Learning Style Model and Lecture & Drill Method) showed a significant improvement. (3) The gain score of the experimental group was significantly higher than the control group's gain score. (4) The interest level of learners after the interventions in both groups was categorized as high. (5) However, the interest level of the experimental group was significantly higher than that of the control group.

Based on these findings, it is recommended that basic mathematics operations such as addition, subtraction, division, multiplication, and algebraic concepts be reinforced through additional interventions at lower grade levels, including Grade 10. While the Pure Lecture and Drill Method remains relevant, it alone is insufficient to increase problem-solving ability. Teachers should assess their students' learning styles to develop activities that cater to different types of learners. Additionally, the learners' interest levels should be considered before and after the teaching process. Teachers should explore other methods focused on learning styles, such as Gardner's Multiple Intelligence and Dunn & Dunn's Learning Style, and include activities in lessons that promote student interest, as this helps maintain motivation to learn.

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PROJECT MASCIEYA: ITS IMPLICATION TO THE MASTERY LEVEL OF GRADE 8 LEARNERS IN KINETIC AND POTENTIAL ENERGY

JENELYN D. TABLADA
Secondary School Teacher III
Canabuan National High School, Santa Fe District

Abstract

The study aimed to assess the mastery level of Grade 8 students at Canabuan National High School in Kinetic and Potential Energy using Project maSCIEya. A one-group pre-posttest design was used to evaluate learners' comprehension of the concepts, and a descriptive-evaluative research design was employed to identify significant differences between pre-test and post-test results. The study included 18 male and 10 female Grade 8 students, one Junior High School Department Head, two science teachers, and the school head as data sources, ensuring alignment with the research objectives. Findings showed an increase in students' mastery levels and significant improvement in their understanding of kinetic and potential energy concepts. The positive impact of the intervention on students' learning was affirmed through their experiences, demonstrating the effectiveness of Project maSCIEya in enhancing student understanding and application of scientific concepts. Recommendations included incorporating hands-on activities to address students' challenges, utilizing Project maSCIEya for other science competencies, encouraging peer teaching, and expanding the strategy to other subject areas based on positive feedback.

Keywords: Experiential Learning, Hands – on Activities, Experimentation, Independent Cooperative Learning (ICL)

Introduction

The K-12 Basic Education Curriculum was implemented to provide a well-rounded education, with science education playing a crucial role in developing critical thinking and problem-solving skills. However, many Grade 8 learners struggle with concepts like kinetic and potential energy due to limited instructional materials and traditional teaching methods. The low performance in science ranking of the Philippines in the PISA 2018 findings further highlights the need for improvement in science education.

Project maSCIEya aims to create an interactive and experiential learning environment for Grade 8 learners. By incorporating hands-on activities and experiments, this approach encourages active engagement and deeper comprehension of scientific principles. Numerous research studies have consistently shown the positive impact of hands-on activities on student learning outcomes. Engaging in hands-on activities has been proven to enhance understanding and mastery compared to solely relying on theoretical instruction. It also improves motivation, interest, and overall learning outcomes. However, effective implementation and instructional support are vital for achieving the desired impact.

To enhance the mastery level of Grade 8 learners in kinetic and potential energy, Project maSCIEya proposes a shift from traditional lecture-based teaching to a more interactive and engaging method. Reports on the least mastered competencies highlight the significant gap in understanding these concepts among students. This research project examines the effectiveness of Project maSCIEya in enhancing

students' understanding and application of scientific principles. It also explores the implications of the findings and proposes recommendations for further improvement in science education. Ultimately, this project aims to contribute to the body of knowledge in science education by addressing the least-mastered competencies among Grade 8 students and investigating the impact of targeted interventions on their mastery level.

Objectives of the Study

The study aimed to assess the mastery level of Grade 8 students at Canabuan National High School for the school year 2023-2024 in Kinetic and Potential Energy by utilizing Project maSCIEya. It involved 28 Grade 8 learners with low mastery of the concept of kinetic and potential energy. Specifically, this study focused on (1) differentiating potential and kinetic energy, and (2) relating the speed and position of an object to the amount of energy possessed by a body.

Methods

The research approach employed in this study utilized a one-group pre-posttest design and implemented Project maSCIEya as a teaching and learning intervention to address the low mastery level of Grade 8 learners in the concepts of Kinetic and Potential Energy. Quantitative data from test results was supplemented by qualitative data gathered through interviews and open-ended questionnaires to capture the learners' experiences. The research followed a sequential explanatory design, starting with a quantitative method and then moving to a qualitative approach.

The study's participants included eighteen male and ten female Grade 8 students from Canabuan National High School, selected based on their similar learning experiences and foundation in science subjects. Mean and mean percentage score were computed to describe the overall mastery level of the participants, and paired t-test was used to determine significant differences before and after the intervention. Thematic analysis was employed to describe the experiences and observations of the learners.

Discussion of Results and Discussion

Table 1. Mastery level of Grade 8 learners on Kinetic and Potential Energy before and after the implementation of Project maSCIEya

Learning Competency	Pretest		Posttest	
	MPS	Qualitative Description	MPS	Qualitative Description
Differentiate potential and kinetic energy. (S8FE-Id-22)	31.43	Very little Mastery	83.33	Mastered
Relate the speed and position of an object to the amount of energy possessed by a body. (S8FE-Id-23)	32.57	Very little mastery	66.14	Very Little Mastery
OVERALL	**32.14**	**No Mastery**	**72.59**	**Approaching Mastery**

The mastery level of Grade 8 learners on Kinetic and Potential Energy before and after the implementation of Project maSCIEya signifies that there was an improvement in both learning competencies. The average score for "Differentiate potential and kinetic energy" increased from 31.43 (Very Little Mastery) in the pretest, which implies that the learners cannot demonstrate the competency, even with the teacher's assistant to 83.33 (Mastered) in the posttest demonstrating

mastery of the competency. Similarly, for "Relate speed and position of object to the amount of energy possessed by a body," the average score increased from 32.57 (Very Little Mastery) in the pretest to 66.14 (Little Mastery) in the posttest, demonstrating a significant increase in mastery levels for both competencies and highlighting the effectiveness of Project maSCIEya. These findings were consistent with the study by Santos and Castro (2019), which revealed that students who participated in hands-on activities in the classroom showed higher levels of understanding and mastery in the concepts of kinetic and potential energy compared to those who only received traditional instruction, emphasizing the effectiveness of hands-on activities in enhancing student learning outcomes.

Table 2. Summary of mastery level of grade 8 learners on Kinetic and Potential Energy before and after the implementation of Project maSCIEya

Mastery Descriptor	Pretest		Protest	
	Frequency	%	Frequency	%
Advanced	0	0	0	0.00
Mastered	0	0	4	14.29
Approaching Mastery	0	0	17	60.71
Little Mastery	0	0	6	21.43
Very Little Mastery	28	100	1	3.57

The data shows that majority of the students were categorized under very little mastery," indicating that the learners have no mastery in the competency and cannot demonstrate mastery even with teachers' assistance during their pretest, while the posttest indicates a significant improvement, with 60.71% of students now categorized as "Approaching Mastery" and 14.29% categorized as "Mastered." This suggests an enhancement in the understanding and application of kinetic and potential energy concepts among the Grade 8 learners following the implementation of Project maSCIEya. Findings of the study was consistent with the study conducted by Lee and Park (2016), which revealed that hands-on activities not only improved students' mastery of subject matter but also increased their motivation and interest in science. This underscores the positive impact of hands-on activities on student engagement and overall learning outcomes.

Table 3. Significant difference on the mastery level of Grade 8 learners in kinetic and potential energy before and after the implementation of Project maSCIEya.

	MPS	SD	DF	t-critical	p-value	Effect size
Pretest	31.57	8.145	26	1.705	0.000*	0.85 (LARGE)
Posttest	72.50	7.408				

** p < 0.0-0.5. Level of significance*

There is a significant difference in the mastery level of the grade 8 learners in kinetic and potential energy as shown on the probability value ($p < 0.000$). The result indicates that the intervention utilized was effective as shown on the large effect size of 0.85. The intervention used in this study demonstrated a significant effect on the mastery level of learners in kinetic and potential energy. This finding was aligned with study of Johnson (2019), which emphasized that students who engaged in hands-on activities in the science classroom demonstrated significantly higher levels of understanding and mastery compared to those who relied solely on theoretical instruction.

Table 5. The responses were summarized in themes and subthemes presented below:

Themes	Sub-themes
Preferred part of the lesson	Experimentation Teacher's Explanation Specific Experimentation
Difficulties faced by the students	Group Dynamics Specific Task Challenges Communication and listening
Impact of the implementation of Project maSCIEya	Favorite Lesson Activities Challenges Encountered Teacher's Impact
Suggestions in the implementation of Project maSCIEya	Desire for Increased time Teacher’s influence on understanding Positive impact of Hands-on activities

The teacher's implementation of Project maSCIEya has significantly enhanced science education and improved scientific literacy among the learners. The commendations from the school and department heads further underscore the teacher's dedication to advancing science education through hands-on activities and experimentation. The project's success, including its expansion to Grade 8 to address least mastered competencies, illustrates the effectiveness of the teacher's approach. The recommendation to extend the project to all grade levels and create more enjoyable learning activities acknowledges its potential to enhance academic achievement and engagement. This serves as an endorsement of the teacher's innovative and impactful instructional strategies, highlighting a positive evaluation of their methods and dedication to improving the learning experience through Project maSCIEya.

Conclusions and Recommendations

The implementation of Project maSCIEya resulted in a significant improvement in the mastery level of Grade 8 learners in kinetic and potential energy. Data analysis showed a clear progression from minimal mastery to approaching mastery, highlighting the positive impact of the intervention. Students' feedback affirmed that hands-on activities and experimentation contributed greatly to their learning, providing more efficient and effective opportunities to understand the concepts.

The statistical significance between pretest and posttest means, supported by findings from related research, underscores the effectiveness of Project maSCIEya in enhancing students' understanding and application of kinetic and potential energy.

Based on these results, it is recommended that hands-on activities be incorporated in teaching various science concepts to address students' challenges. Project maSCIEya could be expanded to address other least mastered competencies in science, given its potential to yield positive outcomes and enhance overall academic mastery. Encouraging peer teaching should also be considered as a strategy to improve communication and learning, fostering a sense of responsibility among students. Additionally, since the School Head, Department Head, and Science Coordinator all provided favorable feedback, it is suggested that this approach be applied to other subject areas to maximize its impact.

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SUPERVISORY AND DECISION-MAKING PRACTICES OF SCHOOL ADMINISTRATORS OF BAMBANG I DISTRICT: BASIS FOR DEVELOPMENT PROJECT

JONATHAN C. PAMITTAN
Head Teacher I
Bambang National High School

Abstract

This study determined the relationship between the supervisory practices and decision-making practices of school administrators of Bambang I District. The quantitative research design was employed and survey questionnaires on supervisory practices and decision-making practices were adapted to gather the necessary data for the study. Results showed that there is a significant difference in the level of supervisory practices of school administrators as assessed by the teachers and the school administrators themselves in terms of the different dimensions with respect to the different criteria. On the other hand, there was no significant difference in the decision-making practices of the school administrators as assessed by the two-group respondents. Moreover, there is a significantly high correlation among the supervisory practices and decision-making practices of school administrators which is described the respondents in conducting their supervisory and decision-making practices are better exercised. It is concluded in the findings that between and among the supervisory practices and decision-making practices of school administrators in this study, significantly high correlations were revealed.

Keywords: Administrator evaluation, educational leadership, quantitative analysis

Introduction

Decision making is universally paramount to adapt to organizational operations with inevitable changes over time. It can occur in school organizations where administrators are perennially challenged to execute quality decisions to effectively manage the changes that come across. It is the role of school administrators to portray ideal decision-making practices and strengthen their supervisory practices. One of the widespread impacts of supervisory practices is seen in its link with decision making practices. In the United Kingdom, for example, there is a policy perspective that good quality supervisory practice is essential to good outcomes (Acharya, 2020). Furthermore, Arcilla (2011) believed that supervisory practices are essential in enabling practitioners to review their practices and develop their decision-making practices. For Arcilla, good supervision enables good decision-making skills out of uncertain and conflicting information.

The researcher, a head teacher himself, has seen how the school administrators in the Division of Nueva Vizcaya were similarly challenged in terms of their supervisory and decision-making practices during the transition of the K-12 Curriculum. Since PPST is a framework of teacher quality replacing the National Competency-Based Teacher Standards (DepEd Order No. 32, s. 2009) framework, much reform and adaptability in the supervisory and decision-making practices were supposed to have been made.

Objectives of the Study

This study comprehensively addressed various aspects related to school administration in Bambang 1 District. It explored the supervisory practices perceived by both school administrators and teachers, including directing, counseling motivation, coordination, human relations, conflict resolution, and information processing. Additionally, the study delved into the decision-making practices perceived by these stakeholders, examining routine, adaptive, innovative, and participative approaches. Furthermore, it assessed whether there were significant differences in perception between school administrators and teachers regarding both supervisory and decision-making practices. The investigation also analyzed correlations among respondents' perceptions of supervisory and decision-making practices.

Methods

This study employed a descriptive research method. Data were collected and reported based on the study's viewpoints, objectives, and basic assumptions. The collected facts include expressions of central tendency, deviation, and correlations, with data discussion conducted up to a level of adequate interpretation. This study aimed to depict the current perceptions of two respondent groups on the supervisory practices and decision-making practices of school administrators in Bambang I. It also had a correlational aspect, examining the relationship between supervisory practices and decision-making practices among school administrators, aiming to provide a comprehensive and thorough interpretation of these relationships.

Results and Discussion

Level of Supervisory Practices of School Administrators as Perceived by Themselves and their Teachers

Table 1. Computed Weighted Mean on the Level of Supervisory Practices of School Administrators as Perceived by Themselves and their Teachers (n=161)

Dimensions	School Administrators			School Teachers		
	Mean	SD	QD	Mean	SD	QD
Directing	4.44	0.57	Practiced at a High Level	4.16	0.91	Practiced at a High Level
Counseling	4.46	0.66	Practiced at a High Level	4.04	0.95	Practiced at a High Level
Motivation	4.62	0.51	Practiced at a Very High Level	4.11	0.87	Practiced at a High Level
Coordination	4.63	0.50	Practiced at a Very High Level	4.26	0.77	Practiced at a Very High Level
Human Relations	4.57	0.51	Practiced at a Very High Level	4.08	0.88	Practiced at a High Level
Conflict Resolution	4.33	0.59	Practiced at a High Level	3.99	0.92	Practiced at a High Level
Information Processing	4.48	0.54	Practiced at a High Level	4.16	0.84	Practiced at a High Level
Overall Mean	**4.50**	**0.56**	**Practiced at a Very High Level**	**4.12**	**0.88**	**Practiced at a High Level**

The overall self-assessment of supervisory practices by school administrators indicates that they practiced at a very high level, with a mean score of 4.50 and a standard deviation of 0.56. In comparison, teachers reported practicing supervisory practices at a high level, with a mean score of 4.12 and a standard deviation of 0.88. This suggests that while both groups engage in supervisory practices effectively, school administrators perceive their practices to be more advanced than those

reported by teachers. The relatively higher mean score for administrators reflects a stronger confidence in their supervisory capabilities, whereas the teachers' scores indicate a solid but slightly lower level of practice. The standard deviations suggest that there is some variability in the teachers' responses, indicating a broader range of perceptions regarding their supervisory practices compared to the more consistent perceptions among administrators.

Decision-Making Practices of School Administrators as Perceived by Themselves and their Teachers

Table 2. ***Computed Weighted Mean on the Decision-Making Practices of School Administrators as Perceived by Themselves and their Teachers (n=161)***

Dimension	School Administrators			School Teachers		
	Mean	SD	QD	Mean	SD	QD
Routine	4.31	0.70	Practiced at a High Level	4.10	0.70	Practiced at a High Level
Adaptive	4.23	0.79	Practiced at a High Level	4.08	0.79	Practiced at a High Level
Innovative	4.28	0.65	Practiced at a High Level	4.17	0.65	Practiced at a High Level
Participative	4.43	0.65	Practiced at a High Level	4.10	0.65	Practiced at a High Level
Overall Mean	**4.31**	**0.70**	**Practiced at a High Level**	**4.11**	**0.70**	**Practiced at a High Level**

Both school administrators and teachers reported conducting decision-making practices at a high level, with mean scores of 4.31 (SD = 0.70) for administrators and 4.11 (SD = 0.70) for teachers. This indicates that, on average, both groups believe they effectively engage in decision-making practices. The mean score for administrators was slightly higher than that of teachers, suggesting that administrators may perceive their decision-making capabilities as somewhat stronger. The standard deviations for both groups are identical at 0.70, indicating a similar level of variability in their responses. This consistent variability suggests that while both groups generally feel confident in their decision-making practices, there may be differing opinions or experiences within each group regarding the effectiveness of those practices. Overall, the results reflected a shared confidence in decision-making between both administrators and teachers.

Difference on the Supervisory Practices as Perceived by the School Administrators and Teachers

Table 3. ***Summary of Significant Difference on the Supervisory Practices as Perceived by the School Administrators and Teachers (n=161)***

Respondents	Mean	Computed *t* – Value	Critical *t*-value	Df	Remarks
School Administrators	4.50	3.089	1.975	159	Significant
Teachers	4.12				

The significant difference in perceptions between school administrators and teachers regarding supervisory practices, indicated by a computed t-value of 3.089, greater than the critical t-value of 1.975 at the 0.05 significance level, suggests that school administrators and teachers view supervisory roles differently. This implies that administrators and teachers may have differing expectations or understandings of how supervisory functions are carried out, which could impact the alignment of goals and practices within the school. Addressing these differences through open communication and collaborative discussions could help bridge any perception gaps and strengthen the effectiveness of supervisory practices.

Difference on the Decision-Making as Perceived by the School Administrators and Teachers

Table 4. ***Summary of Significant Difference on the Decision-Making as Perceived by the School Administrators and Teachers (n=161)***

Respondents	Mean	Computed *t*– Value	Critical *t* – Value	df	Remarks
School Administrators Teachers	4.31 4.11	1.403	1.975	159	Not Significant

The similarity in perceptions between school administrators and teachers regarding decision-making practices, shown by a computed t-value of 1.403, which is less than the critical t-value of 1.975 at the 0.05 significance level, suggested that both groups generally agree on how decisions were made by school administrators. This alignment implies a shared understanding or consensus between administrators and teachers on decision-making processes, which could contribute to a more cohesive school environment and facilitate smoother implementation of school policies and initiatives.

Correlations among the Supervisory Practices and Decision-Making Practices as Perceived by the School Administrators and Teachers

Table 5. Summary of Significant Correlations among the Supervisory Practices and Decision-Making Practices as Perceived by the School Administrators and Teachers

Variables Related	Critical r – Value	Df	Description
Supervisory Practices and Decision-Making Practices	0.529	159	Moderate relationship

There was a significant moderate positive relationship between the supervisory and decision-making practices of school administrators. This indicates that as school administrators' and teachers' perceptions of supervisory practices increase, their perceptions of decision-making practices also tend to improve, and vice versa.

Conclusions and Recommendations

The study revealed contrasting perspectives between school administrators and teachers regarding supervisory practices. While administrators hold high regard for the outcomes of their supervision, teachers often perceive a need for improvement in this area. Furthermore, the research inferred that administrators who perceive themselves as participative in decision-making are viewed by teachers as innovators. The study anticipated differences in perceptions between the two groups, where administrators self-assessed their practices while teachers evaluated and validated these assessments. Despite these differences, the study found no significant variation in how administrators' decision-making practices were perceived by both groups across various dimensions and criteria. It can be inferred from these findings that the perceptions of supervisory practices, decision-making practices, and the overall role of administrators are interconnected in how teachers perceive their school leaders' effectiveness.

It is recommended that a comprehensive training program be implemented to update the theories and skills of school administrators in supervisory practices. Given the complementary nature of assessments from both groups of respondents on decision-making practices, it is advisable to conduct ongoing training and

workshops to sustain or enhance these results. Additionally, intervention measures should be strongly considered to elevate and refine the supervisory practices of school administrators further. Since no significant differences were found in the decision-making practices assessed by both groups of respondents, it is suggested to establish an open communication channel for decision-making and collaborative activities involving both school administrators and teachers. Future research efforts could explore additional strategies to enhance the supervisory and decision-making practices of school administrators, thereby contributing to continuous improvement in educational leadership effectiveness.

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EFFECTIVENESS OF THE 100 INSTRUCTIONAL MATERIALS ON THE LEVEL OF READINESS AMONG KINDERGARTEN LEARNERS

JENYFER J. DELA CRUZ
Teacher III
Bintawan South Elementary School

Abstract

This study dealt with the level of readiness of kindergarten learners using the results of the Early Childhood Care and Development (ECCD) Checklist where Slightly Delayed on the Development (SDOD) flagged which needed to be developed. This study investigated the effectiveness of instructional materials in improving their level of readiness. The descriptive approach was employed to assess and evaluate the readiness of kindergarten learners of Bintawan South Elementary School, Villaverde District. The findings of the study showed that the use of the 100 instructional materials has a slight effect and there is no significant difference in the level of readiness among the kindergarten learners. Hence, proposing the conduct of district LAC sessions program to strengthen the implementation on the utilization of the 100 instructional materials. Moreover, instructional materials must be enhanced and there is a need to conduct regular monitoring and evaluation of its implementation.

Keywords: intervention, learning activity sheets, mastery, preschoolers

Introduction

Early Childhood Education (ECE) is one of the most crucial stages to be given emphasis and prepare meaningful and learning opportunities to children aged 5-6 years. Recognizing the importance of crucial years has heightened interest and support during the earliest years in life. Children's experiences during early childhood influence their later functioning in school and affect them throughout their life. Children's practices during early childhood influence their later performance in school and will affect them throughout their days. Developing positive and trusting relationships during the early years of childhood is crucial. These are necessary for cognitive and emotional development, as well as social bonding. Increased physical activity may give motor benefits throughout childhood; early childhood is the most crucial and rapid phase of complete and healthy cognitive development in human life (UNICEF 2017). As a result, a better understanding of the role of physical activity in improving motor skills, cognition, and emotional skills in young children is necessary. (Riethmuller, Jones and Okely, 2009; Fisher et al., 2011)

Instructional materials are means of communication tools which can greatly influence the reception of transmitting messages and information. Through them the transmission of information is made more effective, so that learners can learn in the best way. Teachers intend to use instructional materials to facilitate better understanding of the learners.

Phyllis on Onditi (2018) stipulates some innate advantages of instructional materials to teaching and learning. In terms of instruction, teachers are provided with compelling platforms for conveying information because they raise the level of interest in learning. Moreover, they provide opportunities that stimulate the learner's interest and curiosity towards learning. They are equally indispensable catalysts of social and intellectual development of learners. Abdullahi and Effiong (2015) contend

that instructional materials are locally made or imported that help to facilitate the teaching/ learning process. To provide an effective simulative environment in the process of teaching and learning, many factors such as children's readiness, classroom environment, teaching methods, assessments, and teaching make as impact. Among different factors, teaching aids make a direct influence on both teaching and learning (Rajapaksha & Chaturika, 2015)

Republic Act 10157, or "The Kindergarten Education Act" states that the purpose of Kindergarten Education in the Philippines is to effectively promote the physical, social, emotional, and intellectual development, including values formation of young children so they will be ready for school. According to research conducted by Ohl et.al (2013) excellent fine motors abilities are a prerequisite for kindergarten performance. Fine motors talents refer to the little muscles in the hands and fingers that aid in actions such as picking up objects and gripping a pencil. Cutting and pasting, manipulatives in mathematics, and clapping to learn syllables are all tasks that require fine motor abilities in school.

The DepEd Order No. 47, s.2016, the school may consider learners entering Kindergarten who will turn five (5) years old by the end of August on the condition that the Philippine Early Childhood Development (PECD) Checklist prior to the start of the opening of the school year, to ensure that the learner can meet the expectation of the grade level. The relevance of teacher knowledge and expertise in assessment should be emphasized and the value of assessment in supporting instructors in improving teaching and learning. Teachers should be given the skills and information they require to conduct the assessment properly.

This study deals with the level of readiness among kindergarten learners using Philippine Early Childhood Care and Development checklist and a basis for the proposed enhancement of the learning activities using the 100 Instructional Materials. In the Division of Nueva Vizcaya, Kindergarten teachers have the 100 IMs (instructional materials) based on the National Kindergarten Curriculum Guide, which competencies are being utilized in the teaching and learning process. These instructional materials were designed to completely mold the different skills of kindergarten learners. The result of the Early Childhood Care Development (ECCD) interprets the readiness of the kindergarten learners.

Objectives of the Study

The study aimed to determine the effectiveness of the 100 instructional materials on the level of readiness among the kindergarten learners. It specifically determined the level of readiness of kindergarten learners in terms of gross motor skills, self-help skills, fine motor skills, receptive language, expressive language, and cognitive skills. The study also delved with the level of readiness among the kindergarten learners before and after the conduct of the intervention and found out the significant difference between the level of readiness of the kindergarten learners before and after the utilization of instructional materials as well as the experiences encountered.

Methods

This action research used one group pretest-posttest research design to determine the level of readiness among kindergarten learners based on the results of the ECCD checklist. The descriptive comparative was used in determining the significant difference between their pretest and posttest scores. Mean scores were

also computed. The participants were 20 kindergarten learners. A validated teacher-made comprehension test was used as the instrument and ECCD for posttest. The implementation of the study using instructional materials ended in the second quarter.

Results and Discussion

The level of readiness of kindergarten learners on ECCD competencies.

Table 1. The ECCD pre-test and post-test results of the kindergarten learners

Learning Competencies	Pre-Test		Post-Test	
	MPS	Qualitative Description	MPS	Qualitative Description
1. Social Emotional	93.3	Slightly Delayed on Overall Development	94.6	Advance Development
2. Expressive Language	91.9	Slightly Delayed on Overall Development	95.6	Advance Development
3. Self-Help	88.7	Slightly Delayed on Overall Development	90.3	Advance Development
4. Fine Motor	81.5	Slightly Delayed on Overall Development	86.4	Advance Development
5. Receptive Language	80	Advance Development	81	Advance Development
6. Gross Motor	79.62	Slightly Delayed on Overall Development	95.4	Advance Development
7. Cognitive	73.2	Delayed on Overall Development	79.5	Slightly Delayed on Overall Development
Overall Mean	84.03	Slightly Delayed on Overall Development	88.74	Advance Development

The pre-test overall mean score was 84.03, categorized as Slightly Delayed on Overall Development (SDOD). Conversely, the post-test overall mean score increased to 88.74, indicating Advanced Development. This change represented a slight increase of 4.71% in the readiness level of kindergarten learners, with gross motor skills significantly improving from 79.62 to 95.4. These findings were consistent with the study of Riethmuller, Jones, and Okely (2009) and Fisher et al. (2011), emphasizing the importance of understanding how physical activity can enhance motor skills, cognitive development, and emotional growth in young children.

The mean percentage scores of the kindergarten learners before and after the conduct of the intervention

Table 2. Mean percentage scores during the intervention.

Title of Activities	No. Items	MPS	QD
1. 1st Formative Assessment	35	95.3	Outstanding
2. 2nd Formative Assessment	35	95.29	Outstanding
Overall Mean	**35**	**95.3**	**Outstanding**

Both the first and second formative assessments achieved mean percentage scores of 95.3%, reflecting outstanding performance. The overall mean score from the two assessments further confirmed that the intervention contributed to improving learners' performance and enhancing their skills. This finding was supported by the study of West, Prakash, and Denton (2000), which concluded that test information was most effectively used to evaluate student needs and guide instruction for kindergarten-aged children.

Significant difference between the level of readiness of the kindergarten learners before and after the conduct of the instructional materials.

Table 3. Difference of pre-test and post-test

	MPS	SD	df	t-critical	p-value	Effect size
Pre-Test	95.3	7.4056	19	1.7291	=0.100006	0.192
Posttest	95.29	6.788681				

The computed probability value (p= 0.1000) indicated that there was no significant difference between the pre-test and post-test of the learners with the utilization of the instructional materials. which means that theThis would suggests that intervention could not be the sole factor that affects the improvement of learners' readiness. While there was an increase in the MPS, there was still no indication of learners' improvement as supported by the small effect size (0.192). The small effect size showed no significant increase on the level of readiness of kindergarten learners. However, according to Santos (2012), ECE services use a checklist because they want to evaluate a child's activity overtime, and the acquisition of skills checklist often focuses on what has or has not been accomplished. He went onto say that a checklist makes judgments about activities or learning outside of the learning context and thus fails to capture the entire scope of learning that occurs.

Experiences and challenges encountered in the conduct of the 100 instructional materials.

Experiences and Challenges

The responses of participants reflect the enthusiasm and engagement in the play-based instructional materials as intervention enhancing their skills and level of readiness. They even mentioned that they love answering formative assessments and have a positive and joyful experience with their teacher.it shows the positive responses indicate a supportive and nurturing environment that encourages their growth and development. This is also the same findings of Cama (2015), requiring the knowledge and skills to determine how activities might be combined to promote children's growth and development, as well as how to adjust activities so that they are part of a continuous continuum that responds to children's development.

Conclusions and Recommendations

The findings of the study revealed that there was no significant difference in the level of readiness among kindergarten learners after the utilization of some of the instructional materials. At some point, the instructional materials helped increased the skills reflecting outstanding results in their formative assessments. The learners' responses reflected enthusiasm and engagement resulting in a well performed assessment, and the interest in some activities in colors, shapes and numbers which indicate that they are artistic and numeric. There were factors other than 100 instructional materials that increase their level of readiness.

Instructional materials should be given to develop the necessary skills and address the readiness of kindergarten learners. The proposed school LAC sessions should be conducted as it aims to improve the craft of kindergarten teachers in strengthening the receptive language and cognitive skills of the learners like interactive activities that can be utilized to enhance these skills. There are other factors other than the 100 instructional materials that increase the level of readiness of learners. Regular monitoring on the utilization of the instructional materials to evaluate its effective implementation.

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USING REFLECTIVE ABSTRACTION IN IMPROVING THE PERFORMANCE OF GRADE 11 STEM STUDENTS IN SOLVING SITUATIONAL PROBLEMS IN CONIC SECTIONS

GLANDA P. GARCIA
Teacher III
Bambang National High School

Abstract

This research, conducted at Bambang National High School, investigated how Grade 11 STEM students performed on real-world conic section problems. It involved all Grade 11 students and used a combination of quantitative and qualitative research methods. While both groups performed well initially, the students exposed to reflective abstraction showed a significant improvement compared to the students exposed in other teaching methods. The students in the reflective abstraction group also reported positive experiences such as feeling of motivation and challenge, and appreciation of individual responsibility and usefulness of the method. The study recommends incorporating reflective abstraction into teaching mathematical problem-solving.

Keywords: Critical thinking, reflection, structural abstraction

Introduction

This study addresses the challenge Grade 11 STEM students face in solving real-world problems involving conic sections, a topic in their Pre-Calculus course. The Philippine government, through the Enhanced Basic Education Act (Republic Act No. 10533), emphasizes equipping students with essential skills for life and work. Solving these conic section problems falls under this mandate.

The Department of Education guidelines encourage teachers to reflect on how students learn best. This study explores "reflective abstraction" as a teaching strategy based on research by Ulia et al. (2022) and Jojo and BrijIall (2012) citing Dubinsky (1991). This method is believed to foster critical thinking and problem-solving skills, aiding students in constructing new knowledge and overcoming difficulties with mathematical concepts.

The need for this research stems from the low performance observed by the author, a Pre-Calculus teacher, in solving situational conic section problems. This aligns with findings from Fatmanissa (2018) and Edillo (2021) who identified challenges students face in understanding technical terms and interpreting word problems. Similar to Ozmen's (2020) study, these difficulties hinder students' knowledge construction.

Therefore, motivated by these observations and existing research, this study aims to investigate the effectiveness of reflective abstraction in improving Grade 11 STEM students' performance in solving real-world conic section problems.

Objectives of the Study

This research focused on how well Grade 11 STEM students tackle real-world problems involving conic sections. It utilized a teaching method called "reflective abstraction" and explored its impact on both their performance and their experiences. The study assessed the performance level in solving problems involving conic sections before and after using this method, looking for a significant improvement. Additionally, it delved into the experiences of these students as they engage with conic sections through reflective abstraction, providing valuable insights into the effectiveness of this teaching approach.

Methods

The study focused on the effectiveness of reflective abstraction in enhancing the performance of Grade 11 STEM students in solving situational problems involving conic sections. It used a true experimental design and a descriptive-comparative method to assess students' performance level in problem solving. The study involved two groups from Grade 11 STEM students at Bambang National High School. A total enumeration was used. A 30-item pre and post-test was conducted and validated by the school's quality assurance team. Significant differences in pre to post-test results were determined using an independent t-test with unequal variance at 5% level of significance. An open-ended interview questionnaire was used to determine the experiences of the participants in solving problems involving situational problems in conic sections and was analyzed through open and axial coding system.

Results and Discussion

Table 1. Performance level of the control group before and after the implementation of reflective abstraction

Groups	Pre-test			Post-test		
	Mean	**MPS**	**Qualitative Description**	**Mean**	**MPS**	**Qualitative Description**
Control Group	9.65	65.23	Satisfactory	15.68	75.42	Very Satisfactory
Experimental Group	12.55	73.23	Satisfactory	20.68	8.68	Very Satisfactory

The table showed that the increase in the mean score of the control group and experimental group in solving situational problems in conic sections with the aid of the intervention implies the improved performance level of Grade 11 STEM students. Accordingly, Kariadinata (2021) stated that initiating reflective abstraction is an effective tool for improving a student's performance in mathematics.

Table 2. Difference between the performance level of Grade 11 STEM students in solving situational problems in conic section before and after the implementation of reflective abstraction

	Group	**Mean**	**Sd**	**Df**	**t-stat**	**p-value**	**Effect size**
Pre-Test	Control	9.65	3.44	75	3.78018	0.00031	0.166
	Experimental	15.68	4.24				
Post-Test	Control	12.55	3.34	75	6.97535	0.00000	0.260
	Experimental	20.68	4.53				

The performance level of the experimental and control group was statistically different. This implies that there was a significant difference between the performance level of the experimental group and control group before and after the conduct of the intervention. It can be gleaned further that there was small effect size as indicated by the value 0.166 and 0.260. This result was consistent with the study of Jojo & BrijIall (2012), that reflective abstraction is a powerful tool in the study of advanced mathematical thinking, that could help students develop their critical thinking to provide solution in the difficulty experience by students along mathematical concepts.

Table 3. Experiences and challenges of the learners during the utilization of intervention

Themes	Subthemes
Deeper Understanding	Follow steps Cope up with the lesson See the application of conics
Creative Problem-Solving	Gives more interest Created mental framework Considered the properties of hyperbola Strengthen mathematical skills and problem-solving abilities
Aha Moment	A little bit harder but it is easy at the end Easy as the teacher taught how to do it Started to catch up
Struggle	Not good in math Hard time in recalling formulas Believe that they are weak in math Tired and sleepy due to varied task in school Pressured in solving problems Hard time to adopt with the learning style of classmates
Difficulties with Abstraction	Did not understood the lesson Requires critical thinking skills Don't know how to utilize the steps in problem-solving
Learning Experiences	Connecting math to reality Developing problem-solving skills Encouraging creativity
Challenges Encountered	Initial difficulty Translation challenges Abstraction difficulties Frustration and persistence
How Reflective Abstraction Influence Students' Problem-Solving Skills	Bridges the gap between concrete and abstract Encourage active analysis and model building Fosters creativity and flexibility Develops transferable skills Promotes deeper understanding

Students solving situational problems involving conic sections using reflective abstraction can experience a range of emotions and thought processes. This includes deeper understanding, creative problem-solving, aha moment, struggle and difficulties with abstraction. Generally, using reflective abstraction to solve situational problems with conic sections can be a rich learning experience for students. It can lead to frustration, moments of discovery, and a deeper understanding of mathematical concepts.

Reflective abstraction was a powerful tool for learning comic sections. While it presents challenges, the benefits of deeper understanding, real-world application,

and development of problem-solving skills make it a valuable learning experience. These learning experiences were connecting math to reality, developing problem-solving skills and encouraging creativity. In terms of challenges, initial difficulty, translation challenges, abstraction challenges and frustration and persistence were being encountered by the students.

In essence, reflective abstraction moves problem-solving beyond rote memorization and formula application. It fosters a more holistic approach that develops critical thinking, analytical skills, creativity, and a deeper understanding of mathematical concepts – all of which are essential for effective problem-solving in any domain. Moreover, the learners thought that the intervention influenced them to further enhance their problem-solving skills. Intervention bridges the gap between concrete and abstract, encourages active analysis and model building, fosters creativity and flexibility, develops transferable skills and promotes deeper understanding.

Conclusions and Recommendations

Reflective abstraction improved the performance level of Grade 11 STEM students in solving situational problems in conic sections. It suggests that the four stages of reflective abstraction are effective strategies in solving situational problems. Moreover, positive feedback was noted during the interview from the participants as depicted by their responses that they found difficulty in problem solving situational problem involving conic sections but find it easy when the intervention was introduced.

The study recommends the use of reflective abstraction in teaching problem solving in mathematics to address the difficulty in answering problem solving among the learners wherein the different stages in the reflective abstraction be incorporated in the teaching-learning process as they provide an avenue to better comprehend how to approach problems. The inclusion of the diverse stages of reflective abstraction in the teaching-learning process is essential, as it facilitates a deeper understanding of how to tackle problems effectively.

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