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Solving Mathematical Problems Involving Measures of Central Tendency with the Aid of Project Remedial Class to Enrich Students' Performance in Mathematics Using Alternative Solutions (RECESS)

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mathematical problem-solving skills, measures of central tendency, project RECESS

Abstract. This study examined the effectiveness of Project RECESS in improving the skills of Grade 8 learners in solving mathematical problems involving measures of central tendency. It determined the learners' skill levels before and after the implementation of the intervention and tested whether a significant difference existed between the pretest and posttest scores. A quantitative one-group pretest–posttest quasi-experimental design was used. The participants of this study were Grade 8 Punctuality of Munguia National High School who were selected by the used of cluster sampling demonstrates low mastery in problem solving involving measures of central tendency based on result of the Rapid Mathematics Assessment (RMA). Parental consent was secured before the participation of the learners. A validated 50-item parallel test served as the pretest and posttest instrument. Data were analyzed using mean and standard deviation to determine and describe the level of respondents' skills in solving mathematical problems involving measures of central tendency before and after the implementation of the RECESS strategy. Paired t-test at 0.05 level of significance was used to determine if there is significant difference in respondents' skills in solving mathematical problems involving measures of central tendency. Results showed that the pretest mean score of 26.38 ("Did Not Meet Expectations") increased to 40.05 ("Satisfactory") after the implementation of Project RECESS based from the matrix adopted from the DepEd Order No. 8, s. 2015. The computed t-value of -14.138 indicated a statistically significant improvement. The findings confirmed that Project RECESS effectively improved learners' skills in solving problems involving measures of central tendency.

Introduction

Over the years, mathematics has maintained its status as one of the subjects that students find difficult to deal with. This remains apparent despite educational efforts around the world to address the issue. Included in the efforts is the attainment of quality education as one of the United Nations' Sustainable Development Goals.

The United Nations' SDGs, specifically the SDG 4, supports quality education by providing a comprehensive framework for identifying key challenges and guiding research efforts to improve education systems worldwide. It f*ocuses on inclusive and equitable education* that aims to ensure inclusive, equitable, and quality education for all. Education researchers can focus their studies on addressing disparities in education, such as gender inequality, accessibility for marginalized groups, and educational outcomes across different socio-economic backgrounds and explicitly mentions improving literacy and numeracy, which includes mathematical skills. Researchers and educators are encouraged to focus on developing strategies to enhance early numeracy skills and mathematical literacy, which are essential for further learning and everyday problem-solving.

Problem solving is an essential competency in mathematics. Enhancing problem-solving skills remains a global challenge. Students need to apply math to real-world problems, but without these skills, mathematical knowledge often lacks relevance (Osman et al., 2018; Nursyahidah et al., 2018; Uyen et al., 2021).

Notwithstanding reforms to improve instruction and assessment, learners remain challenged in understanding, applying, and retaining mathematical concepts. This is evident in the Programme for International Student Assessment (PISA) 2023 results, which showed that only 21% of the 81 participating countries performed above the OECD average of 472 points while only 20% had more than 10% of students attaining Level 5 or 6 proficiency, indicative of students' ability to recognize quantitative problems and formulate complex mathematical models to solve them. In 42 countries, less than 5% of students were classified as high performers (OECD, 2019; 2023).

Similar observation is apparent from the Trends in International Mathematics and Science Study (TIMSS, 2023), which showed that enduring challenges in foundational mathematics exist in many countries.

This holds true to the Philippines where Filipino students consistently have registered low proficiency in mathematics in the international assessment tests and in the National Achievement Test (NAT). This problem exists despite several interventions implemented by the Department of Education.

Curriculum in the Philippines focuses on the development of critical thinking and problem-solving abilities through five content strands: Numbers and Number Sense, Measurement, Geometry, Patterns and Algebra, and Statistics and Probability.

Because of this, more systematic and data-driven diagnostic approaches to better understand learners' specific learning gaps were implemented. In response, Division Memorandum No. 265 s. 2025, Monitoring on the Conduct of Rapid Mathematics Assessment (RMA) for Key Stages 1, 2, and 3 for SY 2025-2026, was issued to look into the possible problems in foundational math skill of learners and serves as a baseline measurement tool in determining strengths and weaknesses that need intervention.

In the RMA results during the first quarter, 98% of the Grade 8 learners have not achieved proficiency in the required skills. The challenge lies in students' ability to solve mathematical problems involving statistical concepts, which include measures of central tendency along mean, median, and mode.

Consistent with these findings, similar results were observed in the previous two years. Item analyses indicate that one of the least mastered competencies is calculating and solving problems involving measures of central tendency, with performance levels consistently classified under "low mastery."

According to Ismail & Shiau (2015), researchers have heavily studied students' understanding of measures of central tendency, focusing so much on mean and only few have focused on median and mode. There were also studies which have greater focus on mastering the computational part and memorizing the formula in order to answer statistical questions. But despite this, students remain challenged in understanding the mean concept. Woldemicheal (2015) supported this by stressing that difficulties in students' understanding is due to the abstractness of the statistical concepts of the measures of central tendency.

According to Flores et al. (2022), calculating ungrouped and grouped data under measures of central tendency poses challenges for both teachers and students due to insufficient prior knowledge in statistics. In addition, Nabayra (2022) emphasized the struggles of students in mastering mathematical concepts, particularly in the context of the "new normal" learning environment.

Students find difficulty with the concept of measures of central tendency (Siew & Saidi, 2018).
This empirical observation also occurs in Nueva Vizcaya as reported in the Division Contextualized Achievement Test results for Grade 10 students through the Division Memorandum No. 334, s. 2023. In the document, students were reported to have registered a Mean Percentage Score (MPS) of 67.11% in mathematics. This still shows persistent learning gaps, which indicates a need for more learning interventions that will resolve students' difficulties in the subject.

Responding to these difficulties, the College of Teacher Education Research and Development Agenda of Nueva Vizcaya State University ensures that their research-driven initiatives would strengthen the educational system. Through its focus on instruction and curriculum development, pedagogical competence, learning management, and the assessment and evaluation of student learning, *classroom needs are practically addressed.*

Ranking low in mathematics proficiency underscores the urgency to address learning gaps and enhance teaching methodologies. In line with the Department of Education's agenda and educational policies such as DepEd Order No. 12, s. 2020, entitled Adoption of the Basic Education Learning Continuity Plan for School Year 2020-2021 in Light of the Covid-19 Public Health Emergency, in line with the goals of RA 10533 or the Enhanced Basic Education Act of 2013, Munguia National High School as one of the institutions that promote quality education adheres to the implementation of PROJECT

RECESS that aims to provide the students a better understanding on their lesson and to address their needs, especially those who cannot learn independently, decrease the number of non-numerate students, deepening the level of understanding of students in dealing with problem solving involving measures of central tendency, and eradicate frustrations of students towards the subject.

Although previous studies have explored students' understanding of measures of central tendency, much of the existing literature focuses on computational skills of higher grade levels. There is a noticeable lack of intervention-based and grade-specific research that examines and improves Grade 8 students' problem-solving skills involving measures of central tendency, particularly in interpreting and solving contextualized mathematical problems. This gap entails the conduct of a study that will enhance these skills among Grade 8 learners.

The researcher, a mathematics teacher, maintains the idea that mathematics is one if not the least favored subjects by students in all levels. From this point of view, the researcher devised RECESS at Munguia National High School to help struggling grade 8 students. This project will be helpful to parents as it provides students free tutorial services that are availed within the school.

Support systems for learners have been the focus of studies conducted prior to the present study. For example, Macaraeg (2025) cited the meta-analysis of Evidence Based Mentoring, which explains the favorable results of school-based mentoring. It emphasized the noticeable benefits that emanate from a well-organized mentor-mentee relationship. Experiencing this circumstance creates a supportive, friendly school environment that contributes to students' personal growth.

Further studies cited by Macaraeg (2025) maintain the influence of interactive and enjoyable activities to make students capable of thinking critically to improve their academic performance. Meta-analyses of active learning in STEM fields have found that methods involving hands-on problem solving, group discussions, and game-based elements significantly reduce failure rates and improve test scores compared to traditional lectures. This is attributed to the motivation, enjoyment, and concentration students get in gamified approaches. Since students cocreate learning experiences, they have greater chances of further developing their critical thinking, collaboration, and self-confidence.

In support to the national educational goals and research agenda, this study aimed at helping grade 8 students at Munguia National High School improve understanding measures of central tendency. By implementing "REmedial Class to Enrich Students' Skills in Mathematics Using Alternative Solutions or RECESS," an intervention was provided to the students to enhance their mathematical skills. Project RECESS aims to address students' weaknesses in mathematics through the use of Simplified Learning Activity Sheets based on least mastered competencies. The project seeks to enhance learners' numerical abilities, improve the academic performance of students in mathematics, and develop their problem-solving skills through the application of Polya's Problem-Solving Method. This project will be implemented during the fourth quarter. Since the least mastered competency for Grade 8 is measures of central tendency, the remediation will be conducted for two weeks. Project RECESS allows students to work both individually and cooperatively and engages them in with the use of online platforms during activities that are suited to the development of 21st-century skills. This responds to the call for cultivating a thirst for knowledge and intellectual values that could be applied beyond the classroom.

The National Research Agenda for Teacher Education strongly supports the K–12 curriculum. Hence, this study is aligned with content knowledge and its application within and across curriculum areas, as well as teaching strategies and innovations geared toward enhancing 21st-century competencies and fluencies. This framework serves as a guide in upholding the quality education needs of students.

In addition, the College of Teacher Education Research and Development Agenda of Nueva Vizcaya State University significantly contributes to the educational system. This study is aligned with its focus on instruction and curriculum, particularly in strengthening pedagogical competence, managing learning, and assessing and evaluating students' academic performance.

To address this gap, the present study focuses on improving Grade 8 students' skills in solving mathematical problems involving measures of central tendency through the implementation of *RECESS* strategy. Findings may serve as a guide to teachers, school leaders, and school administrators to develop effective strategies and interventions to support and improve the mathematics performance of students.

Methodology

This study employed quantitative research approach utilizing a one-group pretest–posttest quasi-experimental design to determine the effectiveness of the Remedial Class to Enrich Students' Skills in Mathematics using Alternative Solutions (RECESS) strategy in improving Grade 8 respondents' skills in solving mathematical problems involving measures of central tendency.

The respondents of this study were Grade 8 Punctuality of Munguia National High School who were selected by the used of cluster sampling demonstrates low mastery in problem solving involving measures of central tendency based on result of the Rapid Mathematics Assessment (RMA). Parental consent was secured before the participation of the learners.

The statistical instrument that was used was the self-made pre-test and post-test which was validated by the panel of experts. The reliability analysis was conducted using KR20, which yielded a coefficient of 0.87, indicating that the test is highly reliable and internally consistent.

For the transmuted percentage score (PS) of the participants in the pre-test and post-test, DepEd Order No. 8, s. 2015 was used as the basis for the computation and its corresponding qualitative description.

The following steps were undertaken:
Pre-Test - The validated 50-items test were pilot-tested in one section of the Grade 8 classes not handled by the researcher to ensure objectivity and minimize bias. After establishing the reliability of the instrument, the researcher administered to the selected Grade 8 Punctuality to determine their initial level of skills.

Implementation of Project RECESS – It was implemented during scheduled remedial class sessions. Respondents were exposed to structured remedial lessons focusing on solving problems involving measures of central, guided problem-solving tasks were provided, use of online platforms during both individual and group activities.

Post- Test – After the intervention, the same 50- item tests was again administered to measure any improvement in respondents' skills after exposure to the RECESS strategy.

Data Collection - The pretest and posttest scores were then collected checked, tabulated for statistical analysis and to determine the respondents' level of performance before and after the intervention and to test the significance of the difference.

The data gathered from the pretest and posttest were analyzed using the following statistical tools.
Mean and Standard Deviation - These were used to determine and describe the level of respondents' skills in solving mathematical problems involving measures of central tendency before and after the implementation of the RECESS strategy.

Paired Samples t-test – To determine if there is significant difference in respondents' skills in solving mathematical problems involving measures of central tendency.

This study strictly observed research ethics prior to the conduct of the study, the researcher sought approval from the school administration and concerned authorities to administer the research instruments and implement the intervention. Consent from the participants and relevant stakeholders was secured to ensure ethical compliance throughout the research process. Confidentiality and anonymity of the participants were maintained, and all collected data were used solely for academic purposes.

Results and Discussion

To determine the effectiveness of the Project RECESS, the researchers collected data on the solving mathematical problems involving measures of central tendency before and after the implementation of the project. Researchers then compared the gathered data through mean, standard deviation, percentage and paired sample T-test.

	Pre-Test			Post- Test		
Measure of Central Tendency	**Mean Score**	**SD**	**Interpretation**	**Mean Score**	**SD**	**Interpretation**
Mean	11.27	2.78	Did Not Meet Expectations	15.80	1.85	Fairly Satisfactory
Median	10.50	3.36	Did Not Meet Expectations	16.64	1.73	Satisfactory
Mode	4.61	1.93	Did Not Meet Expectations	7.61	1.42	Fairly Satisfactory
Overall	26.38	6.63	Did Not Meet Expectations	40.05	3.35	Satisfactory

Table 1 Level of Respondents' Skills in Solving Mathematical Problems by Measures of Central Tendency before and after the Implementation of Project RECESS

Table 1 presents the level of respondents' skills in solving mathematical problems by measures of central tendency - mean, median and mode - before and after the implementation of Project RECESS. It shows that during the pre-test all the mean scores of the respondents yields to "Did Not Meet Expectations" based from the DepEd Order No. 8, s. 2015. The over-all mean of 26.38 also indicates "Did Not Meet Expectations" supported by the computed standard deviation of 6.63 where respondents exhibit poor performance in mathematical problem solving. This indicates that respondents' performance along these areas was extremely low, signifying that many respondents struggled significantly with the mathematical tasks in the pre-test and the respondents *did not meet the required learning standards* and needs remediation.

Following the implementation of Project RECESS, an improvement in performance was observed. Among the three measures of central tendency the highest mean score is the median with a mean score of 16.64 which described as "Satisfactory" and a standard deviation of 1.73. The over-all mean score of 40.05 with a corresponding standard deviation of 3.35, indicating that the respondents generally achieved a satisfactory level of performance after the implementation of Project RECESS. This means that the respondents' met expectations and showed adequate mastery. The lower standard deviation suggests that the respondents' scores were more consistent, reflecting a more uniform understanding of the measures of central tendency.

These findings are supported by Baggaley (2015), who emphasized that mastering measures of central tendency, such as mean, median, and mode, is crucial for students to effectively interpret and analyze data. These statistical concepts serve as foundational tools for making sense of numerical information and drawing valid conclusions from data analysis. Without a solid understanding of these measures, students may struggle to make informed decisions based on statistical information.

	Mean	**Difference**	**Computed t-value**	**p-Value**	**Remark**
Pretest	26.38	13.67	-14.14	<0.01	Significant
Posttest	40.05				

**0.05 level of significance*

Table 2 Test of Differences on the Respondents' Skills in Solving Mathematical Problems Involving Measures of Central Tendency before and after the Implementation of Project RECESS

Table 2 presents the test of differences on the respondents' skills in solving mathematical problems involving measures of central tendency before and after the implementation of Project RECESS.

The results show that the respondents' level of skills in solving mathematical problems involving measures of central tendency significantly improved after the implementation of Project RECESS. The pretest mean score was 26.38, while the posttest mean score increased to 40.05, resulting in a mean difference of 13.67.

The computed t-value of -14.14 and a p-value of less than 0.01 indicate a statistically significant difference between the pretest and posttest scores. This means that the improvement in the respondents' performance was not due to chance but was influenced by the implementation of Project RECESS. Therefore, the intervention effectively enhanced the respondents' skills in solving mathematical problems involving measures of central tendency. The intervention conducted had a positive impact, with fewer respondents remaining at the lower mastery levels and more progressing to higher levels of word problem mastery.

The above findings led to the rejection of the null hypothesis, which states that there is no significant difference in the respondents' level of skills in solving mathematical problems involving measures of central tendency before and after the implementation of the RECESS strategy.

The positive gains observed in this study are consistent with the findings of Laciste and Capua (2021), who emphasized the importance of structured instructional interventions in improving students' problem-solving proficiency. Similarly, Dahunan (2023) found that contextualized instructional interventions in teaching measures of central tendency significantly improved students' posttest performance. These findings suggest that when learners are provided with structured guidance and contextualized learning experiences, they are more likely to develop stronger conceptual understanding and problem-solving skills.

In summary, the findings indicate that the implementation of Project RECESS was effective in enhancing respondents' skills in solving mathematical problems involving measures of central tendency. The significant improvement in the respondents' posttest performance suggests that targeted instructional interventions and structured problem-solving strategies can help address learning gaps and promote better mathematical understanding.

Conclusion and Recommendations

The respondents' initial skill levels were low, indicating limited proficiency in solving mathematical problems involving measures of central tendency. Most respondents did not meet the expected learning standards, indicating difficulties in understanding and applying concepts such as mean, median, and mode.

After the intervention, respondents' performance significantly improved, indicating that Project RECESS effectively enhanced their understanding of statistical concepts and problem-solving skills. Therefore, its implementation can help improve students' academic performance in statistics and may be adopted or adapted by teachers to strengthen conceptual understanding and reduce learning gaps in similar topics.

The paired t-test results revealed a significant difference between pretest and posttest scores, confirming that the gains in respondents' skills were not due to chance. This demonstrates that Project RECESS is an effective instructional strategy for improving respondents' mathematical problem-solving abilities in measures of central tendency.

Based from the findings of this study, the following recommendations were proposed:
Mathematics teachers are encouraged to implement Project RECESS or design similar interventions that may fit the interest of the students to enhance their skills in measures of central tendency. They may consider incorporating structured and engaging learning activities, guided practice, and problem-solving frameworks such as Polya's Four-Step Problem-Solving Model to strengthen learners' analytical thinking and conceptual understanding.

Learners are encouraged to actively participate in structured problem-solving activities and make consistent efforts to practice applying statistical concepts. They should seek guidance whenever they encounter difficulties in understanding mathematical concepts and develop metacognitive strategies, such as reflecting on their problem-solving processes, to improve their comprehension and performance in mathematics.

School administrators and educational stakeholders should provide continuous professional development, appropriate instructional materials, and regular monitoring to support teachers in implementing effective problem-solving strategies, such as Project RECESS, to further enhance students' skills in solving mathematical problems involving measures of central tendency.

The improved and enhanced worksheets and instructional materials developed under Project RECESS may be made available for adaptation by other researchers and educators. These enhanced materials, which incorporate more examples, improved scaffolding, and varied problem-solving tasks, may serve as a ready-to-use resource for future studies and classroom implementation. In this way, Project RECESS can be further validated, replicated, and adapted to strengthen learners' understanding of mathematical concepts, particularly measures of central tendency, across different learning contexts.

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Competing Interests Statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study; all data used were obtained from previously published sources as cited in the reference list.

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Appendices

No appendices are attached to this study.