

DIFFERENTIATED INSTRUCTION IN MATHAMATICS AND STUDENTS' ACADEMIC PERFORAMANCE: A QUASI-EXPERIMENTAL STUDY

Leandy B. Milallos¹, Maedel Joy V. Escote, PhD²

¹Mapaca Elementary School, Mapaca, Compostela, Davao de Oro, Philippines

² Graduate School Faculty Member, Assumption College of Nabunturan, Nabunturan, Davao de Oro, Philippines

ABSTRACT

Differentiated instruction is a pedagogical approach that targets the different learning styles of the learners through the use of different methods which are suitable to individual abilities and interests of learners. This research examined the impact of differentiated instruction on the academic achievement of primary students in mathematics subject. Using a quasi-experimental design, 26 primary students were the subjects of the study. Due to the limited number of students, this utilized one group only which also served as the experimental group. Pretest results show that students performed below average which can be interpreted as very low performance. After the intervention was conducted the mean class improved and the class achieved very high performance. When the significant difference between pretest and posttest was assessed, the results revealed that there was a significant difference between the pretest and posttest results. The study highlighted that differentiated instruction does not only enhance the academic performance of students but it was also found out that their level of engagement and participation in the class improved. These results underscored the effectiveness of differentiated instruction in fostering a more inclusive and effective learning environment in primary education. The implications of this study suggested that incorporating differentiated instruction in the school curriculum can address gaps and support diverse learners more effectively.

Keyword *Differentiated instruction, academic performance, quasi-experimental*

1. INTRODUCTION

Mathematics learning can be challenging as it is difficult to convey some of its concepts. In the aspect of mathematics teaching, there are mathematics teachers who have difficulty in meeting the learning needs of the students. This difficulty might be because of the struggles in considering the diverse abilities, interests, learning style and cultural background of learners (Small, 2017) [1]. Little to no new learning occurs when a learner continues to work on concepts and abilities that have already been mastered. On the other hand, learning does not occur when assignments go much above a students' current level of expertise.

It can be observed in a certain classroom that not all students are performing well. There are certain groups of students who have low performance academically as compared with others. It is a prime duty of the educators to become effective in the classroom in order to be successful in conveying knowledge to the students. There are differing

opinions on how to explain the phenomenon of pupils who struggle at first with mathematics in the classroom. This happens when children are not provided with high-quality mathematics programs and differentiated instruction that makes successful. A certain study conducted in Australia by Gervasoni et al., (2021) [2], applied intervention programs through differentiated instruction approach to students who are not performing well in mathematics. Findings of the study revealed that mathematics learning was improved for students who have participated intervention programs through differentiated instruction approach. It seems that the experience of the intervention program combined with differentiated instruction gave students who were struggling in mathematics fair support and improved their learning and attitudes toward learning the subject.

In the Philippines a study conducted by Aguhayon et al. (2023)[3] on differentiated instruction had successfully helped the students' performance in mathematics. Apart from increasing their academic performance, it also augmented the students' confidence when answering fundamental problems. Additionally, the Philippines' educational system is progressively recognizing and emphasizing the value of differentiated instruction. The Philippine Department of Education (DepEd) is aware of the necessity to accommodate students' various learning preferences, aptitudes, and needs. Through a number of policies and programs, they stress the value of inclusive education. Differentiated instruction is emphasized as a crucial technique for enhancing learning outcomes in DepEd's K-12 curricular frameworks, which was completely implemented in 2016.

The DepEd's K-12 [4] curriculum structure, which was fully implemented in 2016, emphasizes differentiated instruction as a critical method for increasing learning outcomes. It promoted teachers to use a range of teaching techniques in order to meet the particular requirements of their students. This prompted the researcher to conduct a study. The researcher observed the difficulty of the students in grasping mathematical concepts. This urged the researcher to conduct a study, making differentiated instruction as intervention in hopes of improving the students' academic performance in mathematics.

2. METHODS

2.1 Research Design

This study utilized a quasi-experimental research design. A quasi-experimental study is a type of research that possesses significant similarities to experimental research, but does not have complete control over certain factors. This research lacks the random assignment of individuals to distinct groups or circumstances. This study design is employed to assess the impact of an intervention or treatment, although it lacks the same degree of control as a genuine experimental study (Trochim & Donnelly, 2008)[5].

Within the scope of this study, the researcher aimed to evaluate the influence of differentiated instruction on the academic performance of the students. Given a limited number of students, this study employed a single group of students exclusively. This particular set of pupils was designated as the experimental group, which received the intervention involving the implementation of differentiated instruction.

2.2 Research Locale

The study was conducted at Mapaca Elementary School, one of the elementary schools in Compostela, Davao de Oro. The Mapaca Elementary School is at Purok 1-C, Mapaca, Compostela, Davao de Oro. The school has a population of 307 students and is overseen by a school principal. There are a total of 11 teachers who teach students from Kindergarten to 6th grade. The school occupies an area of around 800 square meters. Compostela is a constituent municipality among the 11 municipalities of Davao de Oro. The development of the area began before World War II when the region was predominantly covered by a forest and inhabited solely by the Mandayas, who chose to establish their settlements along the Agusan River. It is a well-regarded municipality that encompasses the expansive plains of the province. To reach this town from Tagum City, one must go along the national highways of Mawab, Nabunturan, and Montevista. According to the 2015 PSA report, the population of the area is 87,474, with a density of 300 people per square kilometer or 780 people per square mile. The municipality is divided into 16 barangays: Poblacion, Aurora,

Bagongon, Gabi, Lagab, Mangayon, Mapaca, Maparat, New Alegria, Panansalan, San Miguel, Siocon, San Jose, Tamia, and Osmeña.

2.3 Research Subject

The subjects of this study consisted of Grade 1 pupils at Mapaca Elementary School who were enrolled during the school year 2023-2024. The study was conducted only with a single group, taking into account the total number of children enrolled in grade 1. They were designated as the experimental group. The intervention employed in teaching this group was differentiated instruction. The researcher employed the universal sampling approach to choose the respondents. Universal sampling is particularly suitable when dealing with a small population, as it guarantees the inclusion of all individuals.

2.4 Research Instrument

To assess the academic performance of the pupils in this study, teacher-created questionnaires were employed. Initially, the pupils were provided with a pretest examination paper. This was created by the researcher and undergone validation by the experts. Subsequently, a post-test questionnaire was administered following the intervention to ascertain the efficacy of differentiated instruction. The questionnaires were a series of questions designed to assess the mathematical proficiency of first-grade students. To guarantee the suitability, the Table of Specifications (TOS) for the test questions was created in line with the Most Essential Learning Competencies of the K-12 curriculum.

The average percentage mean was employed to evaluate the academic performance of students. This scale was modified and derived from Pagtulon-an & Tan (2018) [6] and serves as the foundation for the current grading system implemented by the Department of Education for all elementary grade levels, excluding kindergarten. The average percentage of the students' responses was computed and depicted on the following scale.

Range of Mean	Level of Proficiency	Descriptive Equivalent
Above 90	Exemplary	Very High Performance
86-89	Above	High Performance
80-85	Average	Moderate Performance
75-79	Below	Low Performance
Below 74	Deficient	Very Low Performance

2.5 Statistical Treatment of Data

The following are the statistical tools used in this study:

Mean. This method was used to get the mean of the data by summing all the numbers in the set and then dividing the total by the count of numbers.

Standard Deviation. This was used for determining the variability of pupils' academic performance in mathematics. This provided insight into the extent to which the academic performance of the students varied.

Paired T-test. This was used to determine if the difference in means of the dependent variable (academic performance) was significant after implementing the independent variable (differentiated instruction).

3. RESULTS AND DISCUSSION

The results are presented in accordance with the intended objectives specified for this study. Furthermore, the study comprises revealing the general conclusion of the null hypothesis. Furthermore, this study includes a comprehensive analysis of relevant academic literature that supports and validates its results.

3.1 Level of Students' Academic Performance Before the Intervention

Table 1 shows the result of the students' academic achievement before the intervention was conducted in this study.

Table 1
Students' Academic Performance Before the Intervention

	Mean Class	Proficiency	Indicator
Experimental Group	11.7	59%	Very Low Performance

Table 1 depicted that the mean of students' academic performance before the intervention was 11.7 which also equivalent to 59% class proficiency. This range of mean is below average and can be interpreted as very low performance. Result showed that the students' academic performance before the intervention was very low including its class proficiency and can be interpreted as very low performance. The result in pre-test coincides with the results of students' scores in mathematics in their first quarterly examination wherein less than half of the class passed. This is only one the reasons which prompted the author to look for remedy of the declining result of students in mathematics subject. This study incorporated differentiated instruction as teaching methodology to help students improve their scores in mathematics.

As indicated in numerous studies, mathematics scores in primary students declined in recent years. Specifically, the average scores for 13-year-olds in mathematics fell by 9 points from 2020 to 2023 (NEAP, 2023)[7]. As also observed in several studies, academic performance of students in mathematics is affected by in the incorporation of differentiated instruction. The impact of individualized instruction on primary school pupils' math achievement was examined. The results implied that varied teaching approaches, such tiered assignments and variable grouping, can significantly raise math proficiency among students (Nelsen, 2011)[8]. Additionally, it indicated that children who are exposed to varied teaching approaches perform better than their counterparts in standard settings, especially when it comes to comprehending difficult mathematical ideas and using problem-solving techniques (Tomlinson, 2015)[9].

Similarly, the author also observed firsthand how the students in Mapaca Elementary School struggled in learning mathematics. In fact, the result of first quarterly examination in mathematics where less than half of the class of grade one in Mapaca Elementary School passed. The results also showed that indeed the performance of the students in mathematics before intervention was conducted was below average and can be interpreted as very low.

3.2 Level of Students' Academic Performance After the Intervention

Table 2 presents the data on the academic performance of the students after the intervention.

Table 2
Students' Academic Competence After the Intervention

	Mean Class	Proficiency	Indicator
Experimental Group	17.96 Very High	90%	Performance

Table 2 showed the results of the posttest after the intervention was incorporated. It further shows that the class mean was 17.96 which equivalent to 90% class proficiency and this can be interpreted as very high performance. It further showed that the class mean and class proficiency had increased including its equivalent class proficiency. This result meant that after the intervention the students demonstrated a very high performance. Comparing from the pretest results, students performed better after the intervention was conducted. Apparently, the intervention was effective and it helped improve the performance of students in mathematics subject.

Several studies proved the relevance of differentiated instruction in primary education mathematics. It was found that differentiated instruction has positive impact on the students' academic achievement in mathematics. It further noted that it is important to continuously adapt teaching pedagogies to meet students' individual needs and their learning styles. This could result to higher level of engagement on the part of the students and eventually improve students' academic outcomes (Prast et al., 2023)[10].

As also mentioned by Gregory and Chapman (2013)[11], students are very diverse in terms of their learning adaptability. Each student is unique and they have their own learning style in grasping the subject matter. Teachers therefore must pay attention as to how to cater the needs of the students. This is the very reason why differentiated learning is one of the best strategies in improving mathematical skills of the students. Moreover, the authors of certain

study discovered those talented learners' interest in and proficiency in mathematics increase dramatically when training is designed to engage and challenge those (Assouline et al., 2011)[12].

Tomlinson (2014)[13] added that student needs a conducive classroom that led the students as they learn the concepts in the subject. This should provide the students with activities that help them achieve their own knowledge and ideas, and encourages them to reflect on and apply what they have learned. Differentiated instruction stands out in this situation as significant component that caters the needs and preferences of all students (Smale-Jacobse et al., 2019)[14]. All children were engaged in the learning process through differentiation, which is a dynamic process (Florian & Spratt, 2013)[15].

3.3. Significant Difference of Students' Academic Performance Before and After the Intervention

The table below shows the significant difference of students' academic performance before and after the intervention.

Table 3

Significant Difference of Students' Academic Performance Before and After Intervention

Paired Sample T-test	Df	p	Decision
Experimental Group	25	<0.001	Reject the Ho

The table above shows the result of students' academic performance which was tested for significant difference before and after the intervention. The p value is <0.001 which means that the null hypothesis is rejected. This further implies that is a significant difference of students' academic performance in mathematics before and after the intervention. The increase is very significant which means that the use of differentiated instruction is effective and can generate more interest on the part of the students. Apparently, the significant increase of their performance can be seen in the improvement of their class proficiency from 59% to 90%.

Additionally, the significant effects of differentiated instruction were further reflected in their performance in their mathematics examination. In the first quarterly examination, the class only got 49% passers but in their fourth and final quarterly examination, 81% of the class passed the mathematics exam. The author also observed that students gained relevant mathematical skills after the intervention was incorporated. Students were more engaged in class and participated in different activities. The significant changes observed in their classroom have been reflected in the results of their fourth and final examination in mathematics.

The results therefore coincided with the results of the study conducted by Tambaoan and Gaylo (2019)[16], that students who were taught by differentiated instruction had better performance compared with the students who were taught under the conventional way of teaching. Furthermore, there are many mathematical skills which could be developed well if they are taught by differentiated instruction.

Several studies have demonstrated the effectiveness of differentiated instruction. By attending to each student's unique learning needs, differentiated education can dramatically raise kids' math proficiency. Researchers discovered that when differentiated instruction was used in classrooms, pupils' improvements in arithmetic test scores were higher than those in typical education settings (Tomlinson et al., 2010)[17].

The quality of differentiated instruction provided by the teacher and the methodical implementation of differentiated instruction strategies in mixed-ability classrooms to promote equity, optimize quality, and teach effectively have a significant impact on students' growth (Peteros et al., 2020)[18]. Since the Department of Education implemented the K-12 mathematics curriculum, educators have created primary learning objectives for all students to help them think critically, logically, and positively. This is because differentiated instruction is planned and deliberated to enhance students' mathematical understanding and learning to improve their critical thinking skills (Bhagat et al., 2016)[19].

Another study on the effects of differentiated education on the mathematical thinking process was carried out by Kamarulzaman et al. in 2022[20]. The study's findings show that students' capacity for mathematical thought has been significantly impacted by the activities implemented in the classroom that use tailored education approaches. The ability of the students to express their thoughts and opinions in a variety of ways throughout the teaching and learning processes is the first component. Because the mathematical thinking process necessitates that students share ideas and

communicate with one another, students must continually communicate with the mathematical ideas and concepts they are learning.

4. CONCLUSIONS

The results of this study revealed that, before the intervention, the levels of students' academic performance were interpreted as very low. However, after the intervention was incorporated students' performance in mathematics had improved reaching a level of performance considered to be very high. Furthermore, the analysis of the pretest and posttest scores showed a statistically significant difference, leading to the rejection of the null hypothesis. Therefore, the result of the study suggested that the intervention had a significant positive effect on students' academic performance.

5. ACKNOWLEDGEMENT

The researcher would like to convey her sincere and genuine gratitude to the following people who were part in the realization of this endeavor:

To her parents, Andres P. Milallos and Leticia B. Milallos, they have been the researcher's source of encouragement and motivation;

To her research adviser, Maedel Joy V. Escote, PhD, for her deepest gratitude for her continued support, guidance and encouragement throughout the course of this study. Her wisdom has truly guided the author in finishing this paper;

To Roel P. Villocino, EdD, Dean of Graduate School, for the support to the graduate students and for giving inspiration to finish the study;

To Roel P. Villocino, EdD, Romulo G. Doronio, PhD, Delfin J. Enargan, MA, Panel Committees, for all the constructive criticisms and invaluable suggestions, this greatly contributed to the refinement of this thesis;

To all faculty and staff of Assumption College of Nabunturan for providing a conducive environment for learning. Special thanks to all the professors who have greatly contributed to the knowledge and wisdom of the author;

To Cristy C. Epe, Schools Division Superintendent, Division of Davao de Oro, Maria Bella R. Alvarez, EdD, District Coordinating Principal of Compostela West District, Marivi T. Morabe, School Principal I of Mapaca Elementary School for allowing the researcher to conduct the study;

To the parents and students who have become instrumental in making this research a successful one.

Above all, to Almighty God, the Omnipotent, Omnipresent and Omniscient God for the gift of life, the ultimate source of knowledge and wisdom. His everlasting love and guidance helped the researcher to continue all throughout this academic path.

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