THE EFFECTIVENESS OF DIFFERENTIATED INSTRUCTION ON THE LEARNING PERFORMANCE IN MATHEMATICS AMONG GRADE–FOUR STUDENTS

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ABSTRACT

This action research paper is a quantitative study specifically a quasi-experimental research design aimed to determine the effectiveness of differentiated instruction on the learning performance in mathematics among grade - four students of Poo Elementary School based on the preferred learning styles of the students. In the beginning of the study, the researcher adapted a learning style inventory to determine the students learning styles and the one that prevailed were treated with differentiated instruction. In this study, visual learners was the experimental group as it prevails the inventory and therefore implemented with DI. Aside from that, a researcher - made test questionnaire was used to determine the significant difference of students treated with DI and those who were part of the whole-class instruction. Before the intervention, a pretest was administered and its' findings revealed that the pre-test scores of the experimental and control group were both marked as did not meet expectations. As it implies, there were no significant difference between the pretest scores of both groups before the intervention. Favorably, after the implementation of DI, the experimental group has an outstanding remark on their post-test scores while the control group has a little improvement with a satisfactory remark. With that being said, the pretest and post-test scores differs significantly which proves that DI produces beneficial effects to students' learning specifically in mathematics. As manifested in this particular study, DI is a great instructional strategy to better meet the diverse needs of the students in the classrooms.

Keyword: *differentiated instruction, learning styles, whole-class instruction, learning performance in Mathematics*

1. INTRODUCTION

Educators struggles every day to give quality instruction to their student in the classrooms across all academic subjects (McTighe, 2006). One of the subjects in which educators find it hard to convey their instruction is Mathematics. In fact, mathematical teaching and learning have been a perennial challenge in the Philippine educational curriculum and in different nations as well. Some studies suggested that the complexities and diversities of today's classrooms are significant factors to consider in ensuring the maximum learning competencies of the students. As per Tomlinson (2003), disregarding the variety of the students who occupied the classroom is progressively challenging for educators. To adapt to this variety, instructors need to adjust their instruction, and that implies they need to organize the environmental states of teaching that fit the students' disparities (Smit and Humpert, 2012).

Hence, differentiated instruction, where the students' learning styles are labeled and instructions are differentiated, could be a possible response to these. The differentiated instruction approach has been proven to provide different ways to acquire the content and process ideas for each student. Differentiating instruction is acknowledging various student backgrounds, readiness levels, languages, interests, and learning profiles (Hall, 2002). In that case, they are given an equal opportunity to effectively learn the instruction since it will be based on their unique instructional needs.

According to Tomlinson (2001), differentiation is the modification of teaching and learning routines that address a broad range of learners' readiness levels, interests, and learning modes. It came from the knowledge and a growing understanding of the teacher on how teaching and learning respond to the variety of learners' needs for more independence, more practice to more significant challenges, and more active or fewer approaches to learning. But before conducting differentiated instruction in the classrooms, the students must be profiled as to what kind of learning styles they have. As stated by Shenoy & Shenoy (2013), profiling them according to these learning styles will allow the teachers to understand how learners acquire the information. It will benefit the teachers in a way that they will have a clearer perspective on the proper instruction and teaching techniques implemented in the class.

Additionally, practicing differentiated instruction in schools has been a challenge and added to the complexity of the teacher's role. One of its challenges is the variation of the teaching methods. The danger is when the teaching styles are mismatched to the student's preferred learning style, it can cause students to be inattentive and bored (Newton and Salvi, 2020). It can also cause discouragement and lack of interest in the class, affecting their test scores. This study aims to bridge the gap by implementing differentiated instruction (DI) in the context of identifying the learners' preferred instruction following their learning style to provide them with a quality learning experience in mathematics.

2. REVIEW OF RELATED LITERATURE

Mathematics is a basic aspect of human intellect and logic, according to the International Commission on Mathematical Instruction (2008) since it is an effective technique of developing mental discipline for logical reasoning and mental rigor. Along with the definition cited by ICMI, View Sonic Library (2021) added that Mathematics is a significant scholastic subject since it shows fundamental abilities, for example, the capacity to complete number juggling and permits students to interface the ideas to genuine circumstances. According to Umameh (2011) and Nyaumwe (2013), mathematics education is the foundation and an essential tool for the nation's scientific and economic growth. Since m*athematics* is a gateway to many scientific and technological fields (Rattan et.al, 2012), it should be part of the curriculum not only in the Philippines but to other countries as well. Consequently, numerous countries take mathematics as a mandatory subject since it is a principal subject for human existence (Makondo, 2020).

2.1 Learning and Academic Performance in Mathematics

Mathematics is regarded as the most important subject in Asia and students are encouraged to study it (Leatham et.al, 2008). In most Asian countries, guiding techniques on children's mathematical achievements are far more rigorous, as parents exert extra effort to focus on their children's arithmetic learning (Wei & Dzeng, 2014). Although children's math ability is associated with children's individual factors (Kim et.al, 2019), the teacher's teaching efficacy is important as well in building students understanding and interest in math concepts. Thus, positive achievement motivation of teachers and parents are most important to assure learners better achievement in mathematics (Magi et.al , 2010).

The Philippine Department of Education adopted the K-12 curriculum in 2013, which implies that the Philippine Basic Education Program follows Kindergarten plus 12 years to complete (DepEd, 2012). This action is being taken, according to DepEd, because of the poor quality of basic education in the Philippines, as evidenced by Filipino students' low achievement scores in the National Achievement Test and the international test known as the TIMSS (Third International Mathematics and Science Study) in 2013.

Considering the report posted on 2013, the participation of the Philippines in TIMSS affirmed that the exhibition of Filipino students in national and international reviews on math and science abilities lingers behind its nearby nations like Singapore, South Korea, Hong Kong, Chinese Taipei, and Japan (Care et al., 2015). Also, on the latest results of TIMSS 2019, an international assessment for mathematics and science for Grade 4 students, the Philippines came in last out of 58 countries. Grade 4 Filipino pupils received an average scale score of 249 in science and 297 in math in that report, placing them bottom in both tests. Meanwhile, Singapore, a neighboring country, topped both tests, scoring 625 in math and 595 in science.

Likewise, the results of PISA (Program for International Student Assessment) 2018 also reported that in the Mathematical Literacy, Filipino students scored 353 points on average, much lower than the OECD average of 489 points. On an average, one in every five Filipino pupils met the required proficiency level (Level 2) in Mathematical Literacy. As a result, among the ASEAN countries, Filipino students came closest to Indonesian students in Mathematical Literacy but were still 26 points behind them.

As a result, through Sulong Edukalidad, the Department of Education (DepEd) will lead this national effort for quality basic education by implementing aggressive reforms in four key areas: (1) K to 12 review and updating,

(2) improvement of learning facilities, (3) upskilling and reskilling of teachers and school heads through a transformed professional development program, and (4) engagement of all stakeholders for support and collaboration.

2.2 Factors Affecting the Poor Learning Performance in Mathematics

Studies have shown that a lot of students and even adults had a negative impression towards mathematics (Mazana, 2019). People view it as a difficult subject and as a result, their performance was affected as well. The fear of mathematics (mathophobia), according to Sparks and Sarah (2011), has led different scholars to conclude that mathophobia is a major contributory factor to the challenge of learning and teaching mathematics. This implies that it has a significant impact on elementary students' academic achievement in mathematics. Tata (2013) made his study and emerged with findings that students' negative attitude toward mathematics, apprehension about math, lacking qualified educators, and deficient teaching materials were only some of the causes of poor performance in mathematics.

The fear on the said subject concurs with many scholars who assert that a review of school-based education research has shown that most secondary school pupils find Mathematics as the most difficult, abstract, deadly, and boring subject (Grevholm & Lepik, 2005). According to Armstrong (2009), teachers' methods, mathematical expertise, evaluation, and the structure of the subject of mathematics may all contribute to students' dread of arithmetic. Some people view mathematics as a tough topic and a challenge, and if they are successful in solving mathematical issues, they feel fulfilled and inspired to pursue higher-level mathematics. Conversely, if they fail the sense of failure results in low self-esteem.

On the other hand, the study by Ale (2000) showed that the lack of appropriate materials for use by mathematics teachers compounds the problem of poor academic performance in the subject. Kalejaiye (2005) made similar remarks when he stated that teachers need resources and that a variety of textbooks should be read by the teacher and students since they provide different points of view. Lance (2002) made a similar conclusion when the study pointed out that shortages of important materials such as textbooks have an adverse effect on Mathematics as a whole. In his study, Fagbamije (2004) also confirmed that an insufficient supply of textbooks in schools affects the teaching and learning activities in many nations throughout the world.

Researchers observed that unqualified teachers do not have the experience and skills to properly instruct pupils in mathematical operations can also contribute to the poor academic performance in Mathematics. With that, teachers with a specialty in the subject they teach or in the education of that subject and between 26 and 30 years of teaching experience, according to Armstrong (2009), have a positive impact on student performance. This is consistent with Adeyani's (2008) findings, which revealed that teachers' teaching experience influenced students' learning outcomes as measured by their performance. As a result, a lack of relevant teaching expertise may have a negative impact on students' mathematical performance.

Disregarding differences among students in the classroom can also contribute to poor learning outcomes, not only in math but in other courses as well. According to Levy (2008), students come to class with a variety of capabilities, learning styles, and personalities. As a result, educators are required to ensure that all students fulfill district and state standards by developing adequate interventions to give children with the help they require. One such method is to differentiate education based on a student's learning style. According to Lawrence-Brown (2004), students ranging from gifted to those with major disabilities can get an appropriate education in general education classrooms with appropriate supports, including differentiated instruction. It is in this premise, that this study aims to prove the effectiveness of differentiated instruction in the teaching of mathematics in elementary specifically grade-four learners. Proving the efficiency of DI lays, the groundwork for developing research-based strategies and, as a result, developing the best instructional strategy for students.

2.3 Differentiated Instruction in the 21st Century Classroom

As students in today's schools are becoming more academically diverse, teachers must consider the types of activities they plan for their students. It is therefore important to pay attention to the level and the degree of challenges of these activities (SMU, 2022) by also considering the students choice of learning task based on their readiness, interest, and profile (Sherma & Catapano, 2011).

Chamberlin and Powers (2010) asserted that applying differentiated instruction in the class will give various learning opportunities to the students that ultimately came from the teacher's initiative to differentiate the lesson, the processes and provide support to their students' output. Hence, Marlowe and Page (2005) claim that students' differences are significant enough to be taken into consideration when determining what pupils need to learn, how quick they learn it, and how much support they require from teachers. Students will receive explicit

definitions of information, understanding, and abilities when teachers differentiate by defining students' beginning point of their learning experience (Brimijoin, 2005).

Aside from that, Villa and Nevin (2015) confirmed that when teachers differentiate instruction, they are purposefully and conscientiously making the material, methods, and results of instruction more accessible to all students, regardless of the student's race, gender, ethnicity, language, or differing abilities. As a result, it can be said that with the help of DI, teachers can have a more inclusive teaching philosophy which may in turn result in being a more effective teacher (Thousand et.al, 2015).

Hence, the findings of Stravroula's (2011) study on DI proves that differentiated instruction was effective and positively affects the diverse pupils' characteristics. The study of Westbrook (2011) also revealed that students' learning has improved after differentiating the instruction based on the learners' preferred learning styles. With that, students are more aware of their preferred learning styles and feel more confident to gain knowledge by the means of it. Moreover, students' test results improved significantly once their preferred learning method was incorporated into the instruction, according to Fine (2003). When students were taught using learning style techniques rather than standard teaching methods, their results were much better. This simply means that when students are differentiated based on their needs and targeted learning outcomes, an increase in students' learning achievement will also occur (Cobb, 2010).

However, Mulder (2015) discovered that while differentiation is widely acknowledged to be an important instructional approach for all students, as it is expected to improve each student's learning, there's a little known about the precise relationship between differentiation and student learning. Hayes and Deyle (2001) stressed that it is difficult to determine the potential effects of differentiated instruction on student achievement because the effects of differentiation vary by school and by teachers.

Furthermore, Dee (2010) and Roy et al. (2013) also contend that differentiated instruction is a potential strategy for improving education. Differentiated instruction, they believe, holds the key to academic achievement for all students in a conventional class. Educators, therefore, who are aware of their students' differences or learning needs and use a differentiated instructional approach, should ensure to provide the appropriate teaching practices and maximize the teaching materials to guide the students achieve their educational goals (Faber et.al, 2018).

2.4 Drawbacks of Differentiated Instruction

Nonetheless, instructors cited two major impediments to differentiation, according to McMahon (2019): a lack of time and insufficient resources. Additional to that, according to instructors, include restricted access to differentiated materials, insufficient time to cooperate, trouble producing resources, and ineffective training. (McMahon, 2019). The insufficient knowledge of the teachers proved to be the base factor that may fail the implementation of DI. Dixon (2014) stated that the training courses on DI are essential to prepare the teachers for the challenges differentiated instruction brings and how to face it effectively.

Moreover, time, which includes both preparation and instruction time, is a major determinant of successful DI implementation (Van Casteren et.al, 2017). According to Jager (2016), teachers encounter difficulties owing to time constraints, as they do not have the time to attend to various needs and ensure that pupils understand what is being taught. Mike Cescon of Applied Educational Systems (2021) likewise expressed that differentiation works best when teachers have the opportunity and energy to profoundly consider the necessities of every student so they can fit their classrooms according to those needs.

Also, there are studies which reveals that despite the preparation of teachers in providing differentiated instruction in teaching of Mathematics, other students do not still have a clear grasp of the lesson in the given learning materials (Tsao, 2005). Tsao (2005) used Mathematics Trail in his study which is a dynamic activity instead of static learning activity to promote a new attitude to mathematics through the observation and exploration of the environment. However, it was not effective though it mathematics in this context was contextualized to each learners. Same happened in the study of Yang and Ru Wu (2010), wherein they concluded that the designed teaching method does not work for all students as there are some who are still have difficulty in understanding the questions and the lesson at hand. More so, with the experimental study of Little, McCoach, and Reis (2014), students under DI provides no difference in their achievement than the learners who are treated with traditional instruction.

2.5 Relevance of Differentiated Instruction in Mathematics

According to Ullman (2021), differentiated instruction in mathematics refers to a set of approaches, strategies, and adaptations that a teacher might employ to reach a diverse population of students and make mathematics accessible to all. Furthermore, according to Dr. Kanold (2008), former president of the National Council of

Supervisors of Mathematics (NCSM), diversification in math lessons refers to differentiation at the task's entry and exit points to assist student thinking. Furthermore, this teaching approach proposes that students are provided with a variety of learning opportunities in which the teacher differentiates the content of their lesson, the teaching process and support provided to their students, as well as the students' outputs (Chamberlin & Powers, 2010).

Moreover, differentiated instruction mandates that teachers create chances for students to access, analyze, and display learning through structured lessons (Goddard et al., 2015). As a result, when teachers adapt instruction depending on students' readiness, learning styles, and interests, they may develop a curriculum that are engaging, authentic, and rigorous (Hedrick, 2012). This approach further implies that applying various tools and strategies in teaching mathematics, an educator can help every student maximized their learning experiences.

The National Council of Teachers of Mathematics (NCTM) also encourages educators to differentiate the math instruction considering the differences in learning as well as the ability, interest, and confidence (Ulliman, 2021). Hence, according to Hillier (2011) it must be considered that to differentiate the math instruction, it must support all learners by targeting and addressing specific needs of groups and individual students. As a result, learners' will perform best in the classroom if the content and interaction are matched to their learning styles and academic ability (Adami, 2004).

According to Maggio and Sayler (2013), in mathematics, teachers should meet students' needs by matching their readiness to the level of content delivered. Alburan (2021) stated that students who were taught using differentiated instruction in math performed better than those taught using a conventional instructional approach. Similarly, Bal (2016) discussed differentiated instruction, noting that it is significant in the context of mathematics since it contains multiple levels of sensitivity that enriches learning environments. inAs a result, rather of utilizing a one-size-fits-all technique, this connection can help students accelerate their achievement mathematics (IRIS Center, 2022).

More so, the facilitation of differentiation in teaching and planning is so important that Ollerton (2014) affirmed that a well-planned differentiation includes addressing different depths of the lessons and create a powerful task that help all students' progress. The tasks therefore should be engaging and accessible in accordance with the individual students' access to the lesson without changing the veracity of mathematics (Baker & Harter, 2015). Therefore, this study focuses on the effectiveness of differentiating the instruction in mathematics based on the students' learning styles in the essence of utilizing one learning style in the group of students. With that, the three learning styles mentioned in this study which are the visual leaners, auditory learners and kinesthetic learners will be expounded as to their corresponding teaching strategy.

Students who are visual learners process information most effectively when they can see what they are learning (Heacox, 2002). Rodger et.al. (2009), stated that to differentiate instruction of the visual information, the teacher can present the content in different formats, such as images, flowcharts, diagrams, video, simulations, graphs, cartoons, coloring books, slide shows/Powerpoint decks, posters, movies, games, and flash cards. Visual information can help clarify, establish, and correlate understandings, which can help visually inclined learners activate and engage in learning. Graphical visual representation in the form of Pictorial Base-10 Blocks is a great strategy to help the learners in mathematical solving.

As stated by Fleming (2020), auditory learner is a student who retains information better when the information is being taught through sound. In accordance with the definition of Lincoln Land Community College (2021), an auditory learner preferred an oral instruction, and they can learn best in the way of hearing information from auditory repetition. Wegman (2014) stated that when presenting knowledge to auditory learners, the educator can differentiate the topic by allowing them to express themselves by speaking, since they learn best when they participate in dialogues that include both listening and speaking. Think - Aloud Strategy can be a best strategy for auditory learners.

Lastly, some students prefer to learn kinesthetically. As defined by SBD Inc. (2020), kinesthetic learners need hands-on work and body movement to learn successfully. Logsdon (2021) asserted that they enjoy learning through sense of touch and engaging in learning by using their bodies to move. Because kinesthetic learners find it difficult to focus on a learning assignment, this learning style might be difficult to accommodate. As a result, the teacher can differentiate the subject by incorporating periods of movement throughout the day, which will assist kinesthetic learners focus more effectively. Concrete-Representational-Abstract (CRA) is a good teaching strategy in mathematics for kinesthetic learners.

3. METHODOLOGY

3.1 Research Design

This study utilized a quantitative research design, specifically, a quasi-experimental design. Quantitative research examines the relationship between variables to assess theories. These variables can then be measured using tools, resulting in numerical data that can be examined using statistical processes (Creswell, 2009). The researcher also used a pre and post-test design. The use of this design in this study was to determine the effectiveness of differentiated instruction to grade-four students at Poo Elementary School. According to Frey (2018), pre-experimental research is a study in which participants take a pretest and a post-test before and after treatment to determine the effect of the variable under investigation by comparing the average score of the pretest and post-test.

3.2 Research Instrument

The research instruments utilized in this study was a learning style inventory adapted from Conquering Math Anxiety (2010) of Dr. Cynthia A. Arem and a researcher-made test questionnaire. More so, the learning style inventory was used to identify the students' learning styles. Three styles are included in the Learning Styles Preference Inventory (Math Specific): Visual, Auditory, and Kinesthetic. Among the learning styles, the one that prevailed was treated with differentiated instruction, and the other was part of the whole-class instruction. Aside from that, the researcher utilized a researcher-made test questionnaire which is a competency-based test used to measure the effectiveness of differentiated instruction. The test underwent the tests of validity and reliability. The validity test was done by comparing the questionnaire's content to the curriculum guide by an expert in the field. The reliability test was done using the Cronbach's Alpha in SPSS Statistics, revealing a score of 0.736 ($\alpha \geq 0.7$), which is interpreted as acceptable.

3.3 Respondents of the Study

The respondents of this study were the 16 Grade-Four students at Poo Elementary School in San Vicente, Cateel, Davao Oriental. Complete enumeration, or the use of the entire population as a sample method, was a deliberate choice. Complete enumeration, according to Hale (2011), allows the researcher to look at the population with a specific set of features.

4. RESULTS AND DISCUSSION

This chapter discusses the results obtained from analyzed data of pretest and post-test with a supported review of related literature from previous studies. The discussion was arranged in order based on the objectives of the study: to determine the learner's dominant learning styles; to determine the pretest scores between control and experimental group; to determine the mean comparison between the pretest scores of control and experimental group; to determine the post-test scores of control and experimental group; to determine the mean comparison between the post-test scores of control and experimental group, and lastly; to determine the mean comparison between pre and post-test scores of control and experimental group.

4.1 The Learner's Dominant Learning Style according to: Visual; Auditory; and Kinesthetic

Shown in table 1 the result of the learning style inventory administered in the beginning of the study. The visual learners comprised (9) 55% of the class respondents and were treated with differentiated instruction for it came out as the prevailing learning style. Visual learning is described by Rodger et al. (2009) as the integration of knowledge from visual formats. While the other (7) 45% of the class population was categorized as the control group and treated with the whole – class instruction. As such, this study focused on the effectiveness of differentiating the instruction in mathematics based on the students' learning styles, utilizing one learning style which in this case it is the visual learning style.

Table 1. Frequency distribution table of the students' learning style

Learning Styles	Frequency	Percentage
Auditory	3	15.0
Visual	9	55.0
Kinesthetic	4	25.0
Total	16	100.0

4.2 Pretest Scores between the Control and the Experimental Group

Table 2 presents the learners level of learning performance in mathematics before differentiating the instruction. As seen, both groups scored very low in their pretest. The total score for each category was converted to percentages and interpreted using the Department of Education's description.

Table 2. Pretest scores between the control and experimental group

Group	Total Score	Standard Deviation	Mean	Grade Percentage	Remarks
Control	12	2.41	5.14	71.42	Did Not Meet Expectation
Experimental	12	1.67	4.44	68.50	Did Not Meet Expectation

As observed, both groups got a descriptor interpretation of "did not meet expectation". This means that students are still grasping the basic contexts of the subject and are still adjusting with the topic at hand. The result was in consonance to the Trends in International Mathematics and Science Study (TIMSS) in 2013 and its findings, which shows that in comparison to Singapore, South Korea, Hong Kong, Chinese Taipei, and Japan, Filipino pupils perform poorly in national and international assessments on mathematics and science competencies. (Care et al., 2015).

Additionally, according to the most recent TIMSS 2019 findings, the Philippines placed last out of 58 countries in the international examination for mathematics and science for Grade 4 students. Their report showed that Filipino Grade 4 students scored 249 in science and 297 in mathematics, placing them bottom in both examinations administered by the International Association for the Evaluation of Educational Achievement. Meanwhile, Singapore, a neighboring country, topped both tests scoring 625 in math and 595 in science. The findings were also in line with PISA (Program for International Student Assessment) results from 2018. According to the assessment, fifteen-year-old Filipino pupils scored lower in reading, mathematics, and science than students from most of the countries and economies that took part in PISA 2018. It means that early childhood education in the Philippines has severe challenges that must be addressed in the coming years.

Despite the low performance of Filipino students and the diversity of Philippine classroom conditions, Shena and Tamb (2008) found that Filipino students have the highest level of enthusiasm in learning science and math. It can be seen in their desire to learn and their eagerness to study certain subjects. Filipino pupils, according to Felipe (2006), are developmentally equipped to study abilities assigned by curriculum designers. It may be observed in the way Filipino students are always receptive to change, especially in the educational system that the government has mandated. Finally, Sangcap (2010) stated that Filipino students' motivation and interest in learning can help them improve their math skills.

4.3 Significant Difference in the Pretest Scores between Control and the Experimental Group

Table 3 presents the paired t-test for the significant difference in the overall mean scores of the two compared groups based on their learning performance in mathematics before differentiating the instruction.

Table 3. Mean comparison between pretest scores of control and experimental group

Group	Mean	Standard Deviation	t-value	p-value	Interpretation
Control	5.14	2.41	0.655	0.527	Pretest scores between the two groups do not differ significantly.
Experimental	4.44	1.67			

The researcher inferred that the learning performance of both groups did not vary that much as the mean of the control group is not far from the experimental group. Since t=.655, p=.527, with the p-value being higher than the Alpha level of significance of .05. It is reasonable to assume that there is no significant difference in the learning performance of the control and experimental groups, before differentiating the instruction. The findings of the result only proves that the participants have a varying level of intellectual capacity as it reveals that the variance results are not that big which signify that both groups are heterogeneous; meaning the pupils were of differing level of intelligence. This is a good starting point because the data imply that the study groups are nearly identical in terms of how the scores are distributed. This means that the students are divided into groups based on their abilities (Francis et al., 2016).

Moreover, according to Nusser and Gehrer (2020), heterogeneity in classes is becoming more prominent considering the class population especially in public schools. The findings of their study concluded that in times of increasing heterogeneity in classrooms, there is a great demand for implementing differentiated instruction as it is supposed to support students according to their learning differences. Similarly, Marlowe and Page (2005) claimed that students' differences are significant enough to be considered when determining what pupils need to learn, how quick they learn it, and how much support do they require from their teachers. The study of Levy (2008), also emphasized that disregarding the differences among students in the classroom can contribute to the poor academic outcomes of students. Based on his study, students indeed had a variety of capabilities, learning styles and skills. Thus, the findings of his study mandated that educators are required to fulfill the differences of all learners by developing adequate interventions to give the learners with the help that they require. Nonetheless, Tomlinson (2009) asserted that these differences should be addressed, and the two groups became an ideal grouping for which the experiment on differentiating instruction was conducted.

4.4 Post-test Scores between the Control and the Experimental Group

Table 4 presents the learners' level of learning performance in mathematics after the implementation of differentiated instruction. As observed, there is a slight improvement in scores from the control group even when no differentiation of instruction was performed.

Table 4. Post-test scores between the control and experimental group

Group	Total Score	Standard Deviation	Mean	Grade Percentage	Remarks
Conrol	12	3.30	7.29	80.38	Satisfactory
Experimental	12	1.12	11.0	95.83	Outstanding

Their scores improved under the descriptor interpretation of "satisfactory". The experimental group, on the other hand, received differentiated teaching, and their overall scores improved immensely earning them the description of "excellent". This indicates that the experimental group's differentiated instruction had a significant impact on the students' learning performance.

The findings were supported by Stravroula's (2011) study on DI, which states that DI is effective as it positively affects the diverse pupils' characteristics. It is also like the study of Westbrook (2011), wherein students' learning has improved after differentiating the instruction based on the learners' learning styles. As a result, students are more aware of their preferred learning styles and have more confidence in their ability to learn. Similarly, Alburan (2021) stated that students who received differentiated teaching performed much better than those who received traditional instruction. It implies that this type of approach positively impacted students learning as there is a modified curriculum that is strong in both content and processes (Vacca et.al, 2011). According to the findings of this study, when students are differentiated based on their needs and learning styles, considerable gains in student accomplishment can be observed (Cobb, 2010). Furthermore, when teachers differentiate by identifying the starting point of students' learning experiences, students receive concrete definitions of knowledge, understanding, and abilities (Brimijoin, 2005).

However, some studies revealed that despite teachers' preparation to provide differentiated instruction in mathematics, other students do not have a clear understanding of the lesson in the given learning materials (Tsao, 2005). The same thing happened in Yang and Ruwu's research (2010). After carefully reviewing their students' performance under the designed teaching method, they discovered that it does not work for all students, as some still struggle to understand the questions and the lesson at hand. Moreover, the study supported the findings of Valiandes (2015), who discovered that students made more progress in classrooms where differentiated instruction methods were used systematically than in classrooms where differentiated instruction methods were not used. According to the findings, the teacher's quality of differentiated instruction has a significant impact on student achievement, as does the systematic use of differentiated instruction methods in mixed-ability classrooms in promoting equity, optimizing quality, and increasing teaching effectiveness (Valiandes, 2015).

As a result, according to (Hillier, 2011), differentiated math instruction must support all learners by targeting and addressing specific needs of groups and individual students. Adami (2004) emphasized that if the curriculum and interactions are tailored to the students' learning styles and academic intelligence, they will excel in the classroom.

4.5 Significant Difference in the Post-test Scores between Control and the Experimental Group

Table 5 presents the paired t-test for the significant difference in the overall mean scores of the two groups based on their learning performance in mathematics during the intervention.

Table 5. Mean comparison between post-test scores of control and experimental group

Group	Mean	Standard Deviation	t-value	p-value	Interpretation
Control	7.29	3.30	- 2.851	0.024	Post test scores between the two groups differ significantly.
Experimental	11.00	1.12			

It was deduced that there is a significant difference between the mean of the control group and experimental group, since t= -2.851, p=.024 with the p-value is lower than the Alpha significance level of .05. a significant difference in the students' mathematics learning performance after the intervention was performed.

It is consistent with Fine's (2003) study, which found a significant increase in students' test scores after their preferred learning style was incorporated into the instruction. When students were instructed using learning style approaches rather than traditional teaching methods, their performance improved significantly (Fine, 2003). As a result, these students' attitudes toward learning improved significantly since they felt their strengths were being accommodated. Alburan's study (2021) also confirmed that students taught using differentiated instruction outperformed those taught using a traditional instructional approach.

However, according to McCoach et al. (2014), groupings based on learning styles have no effect on student performance when compared to non-grouping students. Furthermore, Little, McCoach, and Reis (2014) discovered that students on DI do not differ in achievement from the control group. Despite that, as stated by Tomlinson (2005), differentiated instruction is one of the promising approaches to maximizing each student's learning potential. In conformity, the study of Chamberlin and Powers (2010) asserted that this teaching approach benefits students by providing a variety of learning opportunities in which the teacher differentiates the content of their lesson, the teaching process and support to their students, and the students' outputs and supports. Aside from that, students can select learning activities based on their readiness, interest, and profile (Sherma & Catapano, 2011).

4.6 Significant Difference in the Results between Pre and Post-Test Scores

As shown in Table 6, the p-value, which in this case is (.000), suggests the presence of a statistically significant difference in students' performance before and after the intervention of DI. Therefore, the data elucidated that the experimental group's performance improved after being exposed to differentiated instruction. Moreover, differentiated instruction in mathematics benefits students' learning, transforming low mastery levels from the pretest results into higher mastery levels on the post-test (Fernandez, 2020).

Table 6. Mean comparison between pre and post-test scores of control and experimental group

Group	Mean		t-value	p-value	Interpretation
	Pretest	Post Test			
Control	5.14	7.29	6.903	0.000	Pretest and post test scores different significantly.
Experimental	4.44	11.0			

Koeze's (2007) study also demonstrated that differentiated instruction positively affected students' performance. The study found that it improved performance and had an impact on student achievement. It is strongly advised that before implementing differentiated instruction, teachers who use differentiated instruction administer a learning style inventory to their students. The learning style inventory will provide the teacher with the information needed to differentiate lessons based on the preferences and interests of the students (Koeze, 2007). This account is very true with the findings of this particular study wherein visual learner's exemplar that learning based on learner's preferences makes the lesson much more interesting and results in higher retention.

On the other hand, Mulder (2015) discovered that while differentiation is widely acknowledged as an essential instructional approach for all students, as it is expected to improve each student's learning, there's little known about the precise relationship between differentiation and student learning. According to Hayes and Deyle (2001), it is difficult to determine the potential effects of differentiated instruction on student achievement because the impact of differentiation varies by school. On a positive note, Dee (2010) and Roy et al. (2013)

argue that differentiated instruction is a promising approach to improving education. They see differentiated instruction as the key to academic success for all students in regular classrooms, crediting the study's findings.

As a result of this research, teachers who are aware of their students' differences or learning needs and use a differentiated instructional approach already have a view and/or plan for students to gain a deeper understanding of the content, focus more on the objectives, and provide the appropriate teaching practices to help them achieve their educational goals (Faber et al., 2018).

4.7 Implication of Differentiated Instruction in Mathematics Education

This research paper investigates differentiated instruction in relation to fourth-grade students' learning performance in mathematics. The study has educational implications because it adds to the discussion concerning professional development for differentiated instruction to help with the challenges of meeting the needs of diverse learners. Furthermore, this paper emphasizes the effectiveness of differentiated instruction in mathematics, which can be used in the future to teach elementary math classes.

The findings of this research implies that teachers and curriculum developers, specifically in math, may include differentiated instruction in the teaching components of the programs for which they are responsible in a way of maximizing the students' differences based on their learning preferences. Thus, according to Fernandez (2020), the teachers are suggested to develop lesson exemplary integrating Differentiated Instruction and integrate the lesson in the curriculum inputs. From there, let the students engage in activities using the strategy and at the same time teachers are suggested to monitor the development of their students' academic performances to assess any improvements using differentiated instruction.

To conclude, this research suggests that differentiated Mathematics instruction meet the needs of students resulting in greater chance of success. As a result, differentiating instruction in Mathematics may lead to increase accomplishment in elementary school, eventually leading to higher achievement in high school, college, and careers.

5. CONCLUSION

Based on the above-mentioned findings, the following conclusions were made.

1. This study demonstrates that differentiated instruction accommodating students' learning styles, has a positive impact on the academic progress of the students. As the pre-test scores elucidated that the participants failed to reach the desired level of performance, it implies that in the beginning of the study, the experimental and control group has a low understanding as to their current topic in Mathematics.
2. After the implementation of differentiated instruction, the post-test scores showed that the experimental group taught with differentiated instruction had a remarkably better score as compared to control group who were taught the whole-class instruction. This implies that the two groups differ significantly as the average score of the experimental group is higher than the control group.
3. The pretest and post-test scores differ significantly as the data elucidated that the experimental group's performance highly improved after being exposed to differentiated instruction. Therefore, before implementing DI, a learning style inventory should be administered first since this will provide the educator with the necessary information on how to differentiate lessons based on the students' preferences and interests (Koeze, 2007). As to the results of this study, teaching based on learners' preferences makes the lesson more exciting and results to the success of differentiated instruction.

The researcher would like to recommend that educators and curriculum makers may integrate differentiated instruction (DI) and used the approach in teaching pupils in Mathematics, especially in a heterogeneous class as it improves their classroom performances. As manifested in this study, DI is a great instructional strategy to better meet the diverse needs of students through analyzing formative data. Next, educators may implement differentiated instruction (DI) for a longer amount of time. Differentiation works best, according to Mike Cescon of Applied Educational Systems (2021), when instructors have the time and energy to think deeply about the requirements of each of their students and customize their classes to meet those needs. Additionally, to obtain a better understanding of differentiated instruction (DI), the researcher advises that teachers receive in-service training on the method. Differentiated instruction is a more effective strategy to address the needs of all

students and give them a chance to succeed. Finally, future studies may focus on how teachers perceive, engage with, and respond to diversity in the classroom, as many teachers continue to struggle with addressing the diverse class set – up. As a result, research into teachers' perspectives on differentiated was suggested.

6. REFERENCES

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