# THE EFFECTIVENESS OF DIFFERENTIATED INSTRUCTION ON THE LEARNING PERFORMANCE IN MATHEMATICS AMONG GRADE 4 STUDENTS

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**ABSTRACT**

*This study aimed to determine the effectiveness of differentiated instruction for students. To achieve this goal, the major objective of the study is to determine if students that were* employed *with differentiated instruction in their classes performed better than those students who utilized traditional instruction in their classes. Hence, it only focuses on Grade 4 students of Boston Central Elementary School in Boston, Davao Oriental. The researcher uses a pre-test instrument before instruction: traditional instruction (control group); and differentiated instruction (experimental group). The learning styles inventory was used to determine the control and experimental group of the study. With that instrument, the visual learning style prevailed and was regarded as the experimental group of the study. Post-test was administered after instruction to see if differentiation has been effective with the use of mean and t-tests as a statistical tool. The pre-test results showed that both groups did not meet the expectations which do not differ significantly, although the control group's mean score is higher than the control group. However, post-test scores revealed a higher mean score of the experimental group that received the differentiation. Thus, the experimental group's mean score is high enough compared to the control group as it is determined that post-test scores differ significantly. This proves that differentiation is effective as students' achievement is better compared to traditional instruction. On the other hand, the findings of the study indicated that learning is evident to both groups after instruction because pre and post-test scores differ significantly.*

**Keywords:** *differentiated instruction, auditory learning style, kinesthetic learning style***,** *visual learning style, learning performance*

## 1. INTRODUCTION

The trend International Mathematical Science Study Advanced (TIMMS) investigated trends of student accomplishment in mathematics and discovered that there have been some declines in students' scores for over 20 years, with no increases in the countries (Maltese and Tai, 2011). Teachers are still unable to recognize pupils' learning difficulties and modify the curriculum to meet the needs of the students (Jager, 2016) and for that reason, every day, teachers strive to provide greater learning to their pupils.

Teachers, on the other hand, must be knowledgeable of how children learn best to satisfy the needs of their diverse students (Gregory and Chapman, 2013). With that, differentiated instruction has been proven to provide each student with a unique strategy for acquiring knowledge and processing ideas. It also allows for the consideration of a set of attributes such as student backgrounds, readiness levels, languages, interests, and learning profiles (Hall, 2002). Furthermore, in differentiated instruction, they will have an equal opportunity to understand the material because it will be tailored to their specific needs. Teachers must first profile the learners' learning styles before they may deliver differentiated instruction because according to Shenoy and Shenoy (2013), profiling students based on their

learning styles can help teachers understand how students acquire information. Teachers will be informed by the student's preferred learning styles.

Differentiation, according to Tomlinson et., al (2003), is a teaching practice based on great regard for pupils, an understanding of their differences, and a desire to help all students succeed. Though differentiated teaching in schools has been difficult and adds to the teacher's role's complexity (Tomlinson et al.,2014) and the variety of instructional approaches as one of its issues, profiling pupils based on their learning styles can assist teachers to understand how students acquire information (Shenoy and Shenoy, 2013). The problem arises when teaching techniques are incompatible with students' preferred learning styles, which can lead to inattentive and bored students. It may also have an impact on their low exam scores, discouragement, and lack of interest in class (Felder and Spurlin, 2005). As a result, the goal of this study was to close the gap on how to effectively teach mathematics to students by determining their preferred instruction based on their learning styles.

## 2. REVIEW OF RELATED LITERATURE

Mathematics holds a relevant and unique place in the school curriculum as it is important for a better living for the individual. It needs to be taught to students because mathematics is widely used in life, it can be used to present information in various ways toward solving the problem. Moreover, this review of related literature presents a view of Mathematics in the curriculum as well as the factors affecting learning achievement in the said subject. The discussion examines the intervention of differentiated instruction in Mathematics as well as the factors that affect the success of the implementation. This chapter will also flourish on the significant works of theorists that are relevant to differentiated instruction which is the focused of this study.

### 2.1 Mathematics as a Subject

Mathematics is a distinct topic that is an important part of the school curriculum. According to Kitta (2004), mathematics is the language that allows us to express concepts and relationships derived from the environment. It also allows one to make the invisible apparent, solving difficulties that would otherwise be impossible to solve. Furthermore, as established by the International Commission on Mathematics Instruction, mathematics is an effective technique for developing mental discipline and encouraging logical reasoning and mental rigor (ICMI). Mathematics also provides foundational knowledge and abilities for other school topics such as science, social studies, and even music and art. Mathematics gives foundational knowledge and skills for other school courses such as sciences, art, and economics. All students should be able to understand, make sense of, and apply mathematics, as well as create connections between topics and detect patterns throughout mathematics, according to a 2004 Ontario Ministry of Education report.

Mathematics is regarded as one of the most important subjects in Asia, and students are encouraged to study it (Leatham & Peterson, 2010; Ronis, 2008). In most Asian countries, mentoring techniques for children's mathematics achievements are far more active in this regard (Wei & Dzeng, 2014). According to Etcuban and Pantinople (2018), this presentation resulted in an appealing modification in learning behavior. Moreover, in the Philippines, mathematics is a general education subject in primary and higher education where learners are expected to gain an understanding and appreciation of its principles as an applied-using appropriate technology in problem-solving, critical thinking, communicating, reasoning, making connections, representations, and decisions in real life (K to 12 Basic Education Curriculum).

The Trend International Mathematical Science Study Advanced (TIMMS) looked at trends of student accomplishment in mathematics and discovered that student performance has been declining for almost 20 years, with no improvement in the countries studied (Maltese & Tai, 2011). In the instance of Indonesia, the PISA report (2012) revealed that Indonesian students' mathematical success results are extremely poor, with the country ranking 64th out of 65 countries (Ajisuksmo & Saputri, 2017).

The Program for International Student Assessment (PISA) in 2018 which focuses on the core school subjects of reading, mathematics, and science, reported that Filipino students achieved an average score of 353 points in Mathematical Literacy, which was significantly lower than the Organization for Economic Cooperation and Development (OECD) average of 489 points. According to PISA, only 1 out of 5 Filipino students (19.7%) attained at least the minimum proficiency level (Level 2) in Mathematical Literacy. The National Capital Region (NCR)

achieved the highest Mathematical Literacy average score across all the administrative regions with 385 points. Region 7 (Central Visayas) garnered the top average Mathematical Literacy score in the Visayas group of islands, while Region 11 (Southern Mindanao) attained the highest in Mindanao. Among the administrative regions, Region 6 (Western Visayas) had the highest percentage (2.74%) of Level 4 proficient students in Mathematical Literacy.

**2.2 Determining Factors of Students' Mathematics Learning Performance**

As widely believed, interest has a vital role in mathematics learning (Heinze, Reiss, & Franziska, 2005; Yu & Singh, 2016). Yu and Singh (2016) reported an unanticipated result which showed that the relationship between interest and mathematics performance was insignificant and this was opposed by Sauer (2012) asserting that students' interest in learning is one of the contributing factors to success academic performance. The lack of interest and negative attitudes towards mathematics were problems that should be encountered by students in learning mathematics because mathematics is regarded as difficult subject and obscure (Ganal & Guiab, 2014). Gilbert (2016) further added that students with a higher level of interest in mathematics had lower performance-avoidance goals for both types of mathematical tasks which required high and low cognitive processes. Moreover, Kita (2004) explored several factors that consistently affect performance in mathematics among ordinary-level school students in Tanzania. These were such as schools being occupied by unqualified and underqualified teachers that had problems with pedagogical content knowledge and teaching skills. Thus, factors for students' failure according to (HakiElimu, 2013) were inadequate in-service training, few qualified teachers to teach mathematics and poor working conditions.

Furthermore, it is suggested that teachers have to be encouraged to apply student-centered methods that require teachers to actively involve students in the teaching and learning process (Mtitu, 2014, Kafyulilo, Innocent & Ikupa, 2012). Also, the syllabus of URT (2010) and Mtitu (2014) emphasized that teaching methods in mathematics should be learner-centered but the materials available in schools, especially the textbooks, do not reflect this approach to teaching. Kita (2004), explained this by asserting that they do not have enough relevant materials for teaching mathematics that's why there was low student performance in mathematics. Self-efficacy does not represent one's ability, but his beliefs and it affects achievement through the selection of tasks and effort. Moreover, Thien and Ong (2015) pointed out that mathematics anxiety and mathematics self-efficacy did affect Malaysian students' mathematics performance while Pantziara and Philippou (2013) revealed that self-efficacy in mathematics can directly affect students' interest in mathematics. It also affects students‟ motivation, persistence, and achievement (Zimmerman, Bandura & Martinez, 1992; Liu & Koirala, 2009). Thus, Zan and Martino (2008) emphasize that students like mathematics as they can do it and dislike it as they can't do it.

**2.3 Differentiated Instruction in Today's World**

In today's world, rather than sitting all day and listening to the teacher talk in class, the learner might learn more by doing. To meet the requirements of their varied students, teachers must be aware of how students learn best (Gregory & Chapman, 2013). Tomlinson (2003) succinctly states that the classroom can be viewed as a bike race. Every student is provided an opportunity to finish the race at his/her own pace. Thus, differentiated instruction recognizes the value and worth that exist in each individual; it allows students from all backgrounds and with diverse abilities to demonstrate what they know, understand, and are capable of doing (Adami, 2004). However, it is important, of course, to note that differentiated instruction is not a new phenomenon. Differentiated Instruction has existed in various forms throughout the history of teaching, and was in some aspects a facet of pedagogy in the one-room schools that existed until the early 20th century.

As differentiated teaching reaches specific targets, it is also a strategy that offers various approaches based on the instructor's teaching profile, skills, interests, and pre-knowledge as well as the students' learning styles (Adams & Pierce 2004; Levy, 2008; Richard, Omdal, 2007; Tomlinson, 2000). Thus, differentiated instruction in today's world is especially important for children who lack sufficient knowledge and skills in any subject significant to their academic advancement (Richard & Omdal, 2007). Differentiated instruction also contributes to students' cognitive learning by basing learning on students' pre-knowledge with the use of flexible group methods.

**2.4 Role of Learning Styles in Differentiated Instruction**

Learning styles, according to Brown (2000), are how people receive and process information in different learning circumstances. While other researchers defined it as the typical cognitive, affective, social, and physiological

behaviors that serve as relatively stable indications of how learners perceive, interact with, and respond to the learning environment, MacKeracher (2004). Learning style preference, claimed by brown, is one aspect of learning style and refers to the preference for one learning situation or condition over another whereas Murcia (2001) insisted that learning styles as the general approaches that students use in learning a new language or any other subject, such as global or analytic, auditory or visual. Murcia elaborated that Learning style is how a learner perceives, interacts with, and responds to the learning environment and one benefit of a student in identifying his or her learning style is that, it might assist the learner in becoming a more successful problem solver. The more successful an individual is at solving difficulties, the more influence he or she will have over their lives Biggs (2001), posited. This is because the learning style of the students in the form of instruction predicts their comprehension and retention. Thus, there are many distinct differences among the various learning styles (Gregory and Chapman, 2002). Moreover, Honey and Mumford (2009) asserted that understanding of preferred learning styles is very significant. It is critical to be aware of students' learning styles, psychological characteristics (Carthy;1982, Felder & Silverman;1988; Coffield et al.; 2004), and motivational differences for teachers to appropriately regulate lessons (Cuaresma, 2008). As confirmed by Green (1999) on Subban, educators should examine the academic variations of the learners to assist them in integrating the curricular content into their own life and modifying the difficulty of instruction so that all students experience learning success, thereby making learning relevant and engaging to them (2006).

There is no place for fear in a differentiated classroom and students are free to take chances in their learning because learners learn in different ways (Prince and Howard, 2002) while Gregory and Chapman (2013) support this by asserting that students process information in diverse ways. Morgan (2014) further added that teachers who are uninformed of their student's learning styles are likely to instruct in a way that stops students from doing their best work. Thus, the study wants to determine how effective it is if one learning style will be tested to be utilized in a group of students. Thereto, the study will explore the three learning styles and their sample strategy that is included in this study which are the visual learning style, auditory learning style, and kinesthetic learning style. Students with a visual learning style need to see the material to learn it, and this "seeing" can take various forms, including spatial awareness, photographic memory, color/tone, brightness/contrast, and other visual information. Sight is crucial for these students, especially when taking in information and structuring concepts as stated by Fleming (2006), Fleming & Baume (2007), and Drago & Wagner (2004). Visual learners also rely on nonverbal signals like body language from the instructor or facilitator to aid comprehension. "Picture talk strategy" is a good example of this learning style.

However, auditory learners learn best by hearing information. These learners prefer to learn through spoken word classes, conversations, debates, and discussions. Auditory learners understand new ideas and concepts best when they hear the information (Robledo, 2019). When knowledge is explained to them, they tend to grasp it better. Lectures, tutorials, debates, and conversations are the most effective methods for them to learn as noted (Fleming, 2006; Tennent, Becker & Keho, 2005). Thus, according to Flemming (2006), these individuals learn through listening and analyzing information through pitch, emphasis, and speed. Interactive Read-Aloud Strategy can be a good teaching strategy for auditory learners. On the other hand, kinesthetic manage input better and can process faster once their body is busy doing something besides focusing specifically on the material. Thus, Kinesthetic learners learn best by moving and acting as explained (Amran et.al, 2011; Kurilovas et.al, 2014). Vincent & Ross (2001) highlighted that these learners process instruction through touching and feeling what they are learning. In addition to that, Fleming (2006) posited that direct practice, hands-on activities, and learning by doing are preferred by learners. Kinesthetic students will benefit from an active "hands-on" approach to learners who struggle to stay on task and can easily become disoriented.

**2.5 Factors to consider on the Effectiveness of Differentiated Instruction**

Although the concept of Differentiated Instruction is recognized as one of the advantages of catering mixed ability classes (Chien; 2015, Pettig; 2000), many teachers face various challenges in its implementation. According to Tomlinson et.al (2014), practicing differentiated instruction in schools has been a challenge and adds up to the complexity of the teacher's role. The challenges range from internal factors such as self-efficacy to external factors such as time. Dixon (2014) makes certain that teacher training courses on Differentiated Instruction are crucial in preparing teachers for the challenges it brings and how to face them effectively. Teachers' insufficient knowledge of Differentiated Instruction proved to be a base factor that led to many problems in the implementation of Differentiated Instruction. The challenge that relates to the lack of knowledge on Differentiated Instruction is due to the deficiency in the number or quality of training and emphasis on the said subject (Jager; 2017, Boston; 2017,

Lunsford; 2017; Robinson; 2014). Thus, Jager (2016) indicated in her study which employed questionnaires and interviews as tools in investigating South African public secondary school teachers' perspectives of "Differentiated Instruction," the teachers lack knowledge in identifying students' learning difficulties as well as in modifying the curriculum to meet the needs of the students are identified. Furthermore, Suprayogi (2017) and Wan (2015) emphasized a significant relationship between self-efficacy and the implementation of differentiated instruction. Teachers with high self-efficacy tend to have relatively high DI incorporation in their classroom teaching. The low commitment of teachers reported by Merawi (2018) is a barrier to the implementation of differentiated instruction as it affects self-efficacy in a way that becomes very difficult to attain. Although low commitment reflects personal challenges, it was said that it could have its roots in external challenges.

Apart from the internal challenge mentioned above, the employment of Differentiated Instruction in teaching and learning poses challenges from external factors as well. Time, which includes preparation time and instruction time, is a large determining factor in ensuring effective implementation of Differentiated Instruction (Jager, 2013 and Casteren et al., 2017). Due to the nature of differentiated instruction which demands extra modification to teaching aids, the support given, or classroom grouping to cater to groups of varying proficiency levels, teachers find it a heavy workload compared to the existing workload they have (Jager,2017 and Maddox, 2015). Another external factor focused on the students. Students were also one of the highly occurring factors that contribute to the barriers to DI implementation. Besides the well-diverse classrooms (Maddox; 2015, De Neve; 2017, Aldossari; 2018), unprepared (Aldossari; 2018) and undisciplined (Jager; 2017) students serve more complication as teachers intend to differentiate classroom teaching. Aldossari (2018) found that one of the barriers the teachers face was that students were not aware of the importance and significance of Differentiate Instruction and that students are too used to traditional teaching methods.

## 3. METHODOLOGY

### 3.1 Research Locale

Boston Central Elementary School in Boston, Davao Oriental is the site of the study. The school is situated in Purok Kalipayan, Poblacion, Boston, Davao Oriental, near the coast. The 4th level students' building is a three-roomed structure located beyond the storage room (formerly known as the Korean building). To be more explicit, the respondents' classroom is located in the building's middle room.

### 3.2 Research Design

Utilizing a quasi-experimental design, this study compared two variables, the control, and experimental groups, using a pretest and post-test. The purpose of this research is to see if differentiated instruction should be used in mathematics classes. Additionally, the impact of differentiated instruction for the experimental group of grade 4 students at Boston Central Elementary School in terms of enhancing their learning performance in Mathematics will be evaluated. Applying this design to a current situation aids the researcher in developing a plan to improve the situation in the future (VanBaren, 2019). The researchers' main purpose in this study was to find accurate and research-based teaching instruction based on learners' preferences.

### 3.3 Research Instrument

The researcher employed a pre-test and post-test questionnaire which is a researcher-made test and the Learning Styles Preference Inventory questionnaire or The Learning Styles Preference Inventory (Math Specific), adapted from Dr. Cynthia A. Arem's Conquering Math Anxiety, was also utilized in this study. The self-made pre-test questionnaire, which was also used as the post-test questionnaire, was pilot-tested on 20 non-respondents to ensure that each question was valid and subjected to factor analysis. Pilot studies are widely used to assess the viability of procedures, methodologies, questionnaires, and interviews, as well as how they interact in a given context, according to Doody & Doody (2015). The questionnaire underwent content validity testing by a master teacher in the field to ensure the validity of the pre-test. Then, the data gathered was analyzed by the statistician using Cronbach's Alpha in SPSS Statistics which caused a Cronbach's Alpha of 0.700 ($\alpha \geq 0.7$) interpreted as acceptable.

### 3.4 Research Respondents

The study focused on the performance of Grade 4 pupils in mathematics class. The responses were all from Boston Central Elementary School, section Garcia, in Boston, Davao Oriental. Specifically, the section's set B. This section's set B consists of 17 students. Stratified random selection was used to choose the study's participants. Face-to-face classes are utilized at school. Among the three sections provided, the researcher selected one. The researcher chose set B of section Garcia as respondents throughout the course of two weeks because of this classroom set-up.

## 4. RESULTS AND DISCUSSION

Tables detailing the data gathered and its interpretations were presented in this chapter. This chapter's material reflects the study's goal of determining the effectiveness of differentiated instruction based on students' preferred learning styles. The tables were arranged in accordance with the study's objectives. Using a learning type inventory as the basis for differentiation had a beneficial effect (Koeze,2007 & Allcock, 2010).

Thus, with the use of a learning style preference inventory, the researcher was able to identify the most common learning style, which is visual learning which accounts for 76% of the overall population. Furthermore, this chapter highlights the study's findings, which are presented in tables. The results of the learning styles inventory and the respondents' pre-and post-test scores were further reinforced by the review of related literature.

### 4.1 Preferred Learning Style of the Respondents

As seen below, the visual learning style got the highest percentage among the three. Thereby, the dominant learning style among the respondents is the visual learning style and one reason why visual learning is dominant among the rest was visual information is mapped better in students' minds (Williams, 2009).

**Table 1**: Prevailing learning style

| Learning Style | Number of Respondents | Percentage |
|---|---|---|
| Visual Learning Style | 13 | 76% |
| Kinesthetic Learning Style | 2 | 12% |
| Auditory Learning Style | 2 | 12% |
| TOTAL | 17 | 100% |

Sight is crucial for these learners, especially when taking in information and structuring concepts as stated by Fleming (2006), Fleming & Baume (2007), and Drago & Wagner (2004). They also rely on nonverbal signals like body language from the instructor or facilitator to aid comprehension.

### 4.2 Pre-test Scores of the Control and Experimental Group

Table 2 shows that the control group scored higher than the experimental group. As seen below, the mean score of the control group is much higher than the experimental group. Both groups did not meet expectations and as stated by Berry (2008), the initial reason for this was, a pre-test is used at beginning of a course to establish a subject knowledge baseline and then relate it to an end-of-the-course exam to look at knowledge added. Next, a pre-test is used as a way to judge the depth of understanding of prerequisite material. Lastly, the third purpose is to test the students before the material is covered in the course.

**Table 2:** Level of pre-test scores between the control and experimental group

| Group | Total Score | Standard Deviation | Mean | Grade Percentage | Percentage |
|---|---|---|---|---|---|
| Control | 12 | 2.50 | 5.75 | 73.96 | Did Not Meet Expectation |
| Experimental | 12 | 2.27 | 4.15 | 67.31 | Did Not Meet Expectation |

Both groups did not meet the expectations as their remarks and according to DepEd, teachers should ensure that learners receive remediation when they earn raw scores which are consistently below expectations in Written Work and Performance Tasks by the fifth week of any quarter. However, the table presented above shows the student's remarks before instruction. Teachers must be knowledgeable of how pupils learn best to satisfy the needs of a diverse group of students as regarded by Gregory & Chapman (2013). As a result, differentiated teaching is used as an intervention in this study. However, the results above were gathered before the conduct of traditional instruction (control group) and differentiated instruction (experimental group). Thus, neither of the group meet the expectations and the groups have varying levels of intellect, as seen above. However, any variations in performance levels do not prevent any of the students from participating in the study, as stated by Wormeli (2003).

**4.3 Difference of Pre-test Scores of the Experimental and Control Group**

To determine if there were significant differences between the means from the two independent groups, an independent t-test was used to compare the control group and the experimental group's pre-test (Salkind, 2007). The table below shows that pre-test scores between the two groups do not differ significantly and one good reason why pre-test results do not differ was the time of administration where it was administered before a course to establish a baseline of knowledge (Berry, 2008).

**Table 3:** Mean comparison between pre-test scores of control and experimental group

| Group | Mean | Standard Deviation | t-value | p-value | Interpretation |
|---|---|---|---|---|---|
| Control | 5.75 | 2.50 | 1.205 | 0.247 | Pre-test scores between the two groups do not differ significantly. |
| Experimental | 4.15 | 2.27 | | | |

Furthermore, as stated by Berry (2008), the idea behind the pre-tests is to give the students an indication of the material that will be covered and the depth of knowledge required, thus it serves as a 'road map' for the topics. The instructor/researcher also gets a quantifiable measure of the knowledge that students already possess for a particular topic. On the other hand, a significant difference between pretest scores indicates that selection is a likely threat (Chen and Krauss, 2005). With that, the pre-test scores between the two groups which do not differ significantly are a good result. It was even mentioned by Chen and Krauss (2005) that if the experimental and control group are not equivalent before the intervention, any differences in the post-test cannot be interpreted as an effect.

**4.4 Post-test Scores of the Experimental and the Control group**

The table below shows the calculated post-test scores for the experimental and control group. The post-test instrument used in the two groups were of the same content. However, the instrument used for the experimental group is designed solely for visual learners (prevailing learning style). Thus, the mean score of the experimental group who received the intervention of the study is higher as compared to the control group. The control group has a "very satisfactory" remark which a good result but is relatively lower than the experimental group's remarks. However, the experimental group has an "outstanding" remark and the reason for this according to Sternberg and Zhang (2005) is the fact that students profit most when instruction is differentiated to accommodate their differences. Beecher and Sweeny (2008) further posited that achievement gains occurred across student groups that used differentiation. The intervention used in the study which is differentiated instruction has been very effective to the point that it surpasses the control group and got a higher result on the pre-test.

**Table 4:** Level of post-test scores between the control and experimental group

| Group | Total Score | Standard Deviation | Mean | Grade Percentage | Percentage |
|---|---|---|---|---|---|
| Control | 12 | 2.38 | 8.50 | 85.42 | Very Satisfactory |
| Experimental | 12 | 0.95 | 11.08 | 96.67 | Outstanding |

It was clear that the experimental group has better remarks and many educational researchers support this finding that students benefit from instruction that responds to their culture and learning style, as it results in improved

achievement and a more positive attitude toward learning (Tomlinson et al., 2003). Tomlinson further posits that classrooms are more academically diverse than ever and teachers need an instructional approach that enables them to adequately respond to students' individual needs.

### 4.5 Difference of Post-test Scores between the Experimental and Control Group

Table 5 shows that post-test scores between the two groups differ significantly as seen below. As explained in the methods of this study, the experimental group received differentiation of instruction while the control group received traditional instruction.

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

| Group | Mean | Standard Deviation | t-value | p-value | Interpretation |
|---|---|---|---|---|---|
| Control | 8.50 | 2.38 | -3.303 | 0.005 | Post-test scores between the two groups differ significantly. |
| Experimental | 11.08 | 0.95 | | | |

The main reason, however, for the post-test result between the two groups to differ significantly is the fact that students profit most when instruction is differentiated to accommodate their differences (Sternberg and Zhang, 2005). Thus, as seen above, the experimental group got a higher mean score with a 2.58 difference and this is enough difference for the post-test scores of the two groups to differ significantly. Differentiated instruction as an intervention is clear to be very effective. This could be the reason why Walpole and McKenna (2007) acknowledge the positive effect of tailoring instruction to match students' needs. The two authors even asserted that providing students with what they need, through differentiation, maximizes students' growth.

### 4.6 The Difference in the Results between Pre and Post-test Scores

The table below shows that pre-test and post-test scores differ significantly. The control group got a higher computed average based on the pre-test scores gathered. However, if the post-test results of both groups were compared, this time, the experimental group got the leading mean score.

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

| Group | Mean | | t-value | p-value | Interpretation |
|---|---|---|---|---|---|
| | Pre-test | Post-test | | | |
| Control | 5.75 | 8.50 | −3.303 | 0.005 | Pre-test and Post-test scores differ significantly. |
| Experimental | 4.15 | 11.08 | | | |

The results indicate that the experimental group's gain in scores from pre to post-test exceeded the control group's gain in scores. The control group got a higher mean score on the pre-test result while the experimental group scored higher on the post-test result. The data in table 5 revealed that after instruction, both groups of students gained new knowledge. It is, however, evident above that the experimental group who received the intervention (differentiated instruction) performed better and according to Koeze (2007), this is due to the differentiated instruction that had a positive effect on students' performance.

### 4.7 IMPLICATION OF DIFFERENTIATED INSTRUCTION TO MATHEMATICS EDUCATION

Mathematics, according to Kitta (2004), is the language that allows us to express concepts and relationships derived from our surroundings. Mathematics also allows one to make the invisible apparent, allowing one to solve issues that would otherwise be impossible. As a result of this study's differentiation in the classroom, an implication suggests that differentiation is an excellent strategy to use in mathematics classes in heterogeneous classrooms. Furthermore, according to Tortora (2005), implementing the intervention with students is essential to meet the various requirements of all students in the classroom. However, the study's findings implied that in teaching mathematics with differentiation, there is a significant difference between their pre and post-test scores, implying that using differentiated and traditional instruction in the classroom has improved students' learning. Thus, the data presented imply that the experimental group who received differentiation of instruction performed better.

From the aforementioned, the study's overall findings imply that if the teaching method is tailored to students learning preferences/styles, students learning performance in mathematics will have better improvement. With that, the use of differentiated instruction will be an effective intervention to utilize in mathematics classes. However, before the conduct of the study about differentiation, this study implied to make sure that "time" should be highly considered. The researcher had experienced time constraints for the preparation and implementation and this implies that enough time in differentiating instruction is needed to properly implement and avoid problems in getting the desired result of the study. In consonance with this implication, Jager (2013) and Casteren et al. (2017) indicated that in achieving effective Differentiated Instruction implementation, both preparation and instruction time should be included (Jager, 2013; Casteren et al., 2017). Aranda and Zamora (2013) further added that differentiated instruction takes time since students explored, interacted, and collaborated in groups on a variety of activities throughout the eight-week experiment.

## 5. CONCLUSIONS

1. The level of pre-test scores of the students failed to reach the desired level of performance. It means that there is a greater number of respondents that has low scores on the test and were remarked as "Did Not Meet Expectations". According to the DepEd's decision on learners marked as Did Not Meet Expectations, the learner must be re-assessed immediately for instructional intervention. If the learner still fails in the intervention, he/she is allowed to enroll in the next grade level in the succeeding school year with the continuous provision of tutorial services. Pre-tests, on the other hand, are a non-graded evaluation tool used to determine pupils' prior subject learning.
2. The pre-test scores between the two groups do not differ significantly. Therefore, the students were of comparable intellectual ability before the instruction or the conduct of the intervention.
3. The level of post-test scores of the students showed that the experimental group taught with a differentiated approach is remarkably better as compared to those who were taught with traditional instruction. Koeze (2007) strengthened this finding and found that differentiated instruction had a positive effect on students' performance.
4. The post-test scores between the two groups differ significantly as the average score of the experimental group is much higher than the control group. Therefore, the intervention (differentiated instruction) given to the experimental group has been very effective as compared to the experimental group of respondents. This finding is supported by Valiandes (2015) saying whom it was found that students made better progress in classrooms where differentiated instruction methods were systematically employed, compared to students in classrooms where differentiated instruction methods were not employed.
5. The pre-test and post-test scores differ significantly. Therefore, students' learning in both groups is evident after instruction. However, the analysis of the data gathered appears that although the pre-test scores of the control seemed to be higher than the experimental group, it is concluded that the experimental group's learning performance in mathematics was better as they had a higher post-test score after instruction.

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