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Research Article

Enriching the Discussion on the Characteristics of Solid, Liquid, and Gas Through Differentiated Instruction: A Quasi-Experimental Research

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Abstract

Teaching pedagogies are the ways how teachers impart knowledge to the learners. Teachers push boundaries to attain effective teaching-learning process. With the different studies in the literature, the topic characteristics of solid, liquid and gas, was not explored well in terms of looking for a better way of teaching it. This study would like to assess the effectiveness of differentiated instruction as a strategy in teaching characteristics of solid, liquid, and gas among the grade 3 learners of Polo Elementary School- Polo, Alcantara, Cebu, Philippines. There were two groups – experimental and controlled groups – with 15 respondents each. A quasi-experimental research design was utilized in this study. The results displayed an unequal mean (12) for controlled group and (16) for experimental group in the pretest. The posttest delivered a four-point difference from the mean (14) of the controlled group to the mean (18) of the experimental group. With the 0.05 significance level, the results between the two groups were found out to be significant (p=0.05). This result provided a realization that new strategies to be implored in a topic would constitute a significant difference. Thus, this study proved that in teaching characteristics of solid, liquid, and gas with high average students, the students will have better understanding of the topic when differentiated instruction is utilized than using the traditional method of teaching. It is recommended that further study will be conducted of the same strategy and topic but with a different set of respondents to validate the study's outcomes.

Keywords: Differentiated Instruction, New Strategy, Quasi-Experimental Research, Traditional Teaching, Characteristics Of Solid, Liquid, And Gas

Introduction

Numerous learning styles and strategies are extensively accepted in education to point out that all students learn independently in different ways. These are not recipes for teaching students, but they do help teachers identify preferred ways for students to acquire the education they deserve. To help individuals optimize learning, one should consider addressing the challenge of promoting learning conditions while organizing such interactions (Singh, 2017). Students enter the classroom with diverse abilities, interests, needs, and behaviors. The educators are responsible for ensuring that all learners adequately provided quality teaching-learning process. Senthamarai (2018) found that many educational techniques and strategies can be utilized to achieve multiple learning goals, some of which are suitable to a certain set of goals.

However, there is no such thing as perfect instruction. Knowing the different ways is like wearing some ace. With an understanding of the basics of each method, one can fine-tune and innovate teaching styles to achieve each individual needs. There is no best teaching method. Some methods have proven to be more efficient and effective compared to others. In the literature, little to no attention was given to teach specific topics in the elementary year using differentiated instruction as a strategy. With this, the researchers see the urgency of assessing the differentiated instruction as a strategy in discussing Characteristics of Matters among Grade 3 learners will be conducted in Polo Elementary School- Polo, Alcantara, Cebu, Philippines.

In the third grade level, the Science subject is composed of many topics that include the characteristics of solid liquid and gases. It is an interesting topic to learners wherein they will perform well when appropriate methodologies are applied (Mavidou, 2019). Furthermore, the preconceived ideas of the learner's reigns in the topic and so during instruction the science teachers need to identify and address them during instruction to harmonize the conflict between science (Mavuru & Ramnarain, 2018). This is usually delivered through showing pictures, videos, simulations and the like. However, discussing the characteristics of solid, liquid and gases would best absorbing and interesting through differentiated instruction (Doymus, 2007). The practical activities do not confront the engagement

and achievement of the learners but provides them with revision tools (Ellyard et al., 2016) specific information, instructional strategies, assessments, curricular resources necessary to create meaningful learning opportunities and grouping the learners for the variety of other means such as interest and learning profiles which done through differentiated instruction (Lora et al., 2014).

As observed in the actual classroom set-up, differentiated instruction is viewed as one of the teaching strategies that advocates flexibility and variety of instruction. It provides variety of ways in which teacher can use to cater the student's needs (Robinson et al., 2014). Furthermore, it utilized across different subjects and build up collaboration and increases the student's proficiencies. It focuses not only towards one teaching strategy (Alsalhi et al., 2021). Differentiated instruction also caters to different learning abilities of the learners. Student-centered teaching is the focal point of this type of instruction (Bondie et al., 2019). Moreover, it constitutes as the ground where teachers will be able to see the different skills of the learners in acquiring knowledge in an appropriate way (Suprayogi et al., 2017). Additionally, differentiated instruction is a great strategy that must be accompanied by tasks and activities that can arouse students' interest and broaden their knowledge. Conducting classes with appropriate tasks and activities enhances students' performance (Macalapay, 2019). In contemporary classrooms, differentiated instruction becomes more diversified (Subban, 2006). The didactic experts, educators and the academe facilitators are scrutinizing for a teaching and learning strategies that cater the diverse needs of the learners (Muhammad et al., 2017).

In today's classrooms, challenges in dealing with a diversity of learners appears to be inevitable (Cardino et al., 2020). Teachers who understand their students' learning needs help learners make productive decisions in a way they will learn best (Cihad, 2018), thus, allowing them to take responsibility for their learning since the tasks tailored around their interests and they also have a choice in the learning tasks (Carver et al., 2010). In science lesson, differentiated instruction improves the academic achievement and provides long term learning to students (Weselby, 2021). In addition, it also increased the positive attitudes and motivation of the students towards the lesson (Ing et al., 2015) as well as allowing them to have fun in learning (Alavinia & Farhady, 2012).

Research Questions

This study determined the effectiveness of Differentiated Instructions as a strategy in teaching the characteristics of solids, liquids, and gas among Grade 3 learners. Further, this study elicits pertinent information in answering the following questions:

1. What is the pre-test result of the two groups of respondents?
    1.1 Experiment Group
    1.2 Controlled Group
2. What is the post-test result for the two groups of respondents?
    2.1 Experiment Group
    2.2 Controlled Group
3. Is there a significant difference between the pre-test and post-test scores of the controlled and experimental groups?

Literature Review

This section listed the various important references and works of literature that will support considerable claims regarding the significance and applicability of the study's construct. The researchers carefully selected highly refereed, scholarly created articles, publications, and journals, adhering to the core ideas of inclusion criteria based on the standard guidelines in conducting the literature review.

Melesse (2015), emphasized that different factors should be taken into account when teaching diverse learners in the same class instead of using a type of universal approach in which students' readiness, interest and learning profile isn't addressed. This study specifically assessed primary school teachers' perceptions, practices, and challenges of differentiated instruction. Almost all of the primary or the basic school teachers are unfamiliar with the key teaching strategies of differentiated teaching as concluded based on the result. This reference provides a clear understanding that in addressing learners' special educational needs using differentiated instruction, teachers' readiness should also be taken into consideration. In the study of Kotob & Arnouss (2019), it is the educator's goal to identify effective educational strategies that enable diverse learners to reach their full potential. In education, differentiated instruction as a possible approach gained a lot of attention. Examining the effectiveness of absorbing differentiated teaching practices into kindergarten class performances was the study's purpose. The study's results show that the outcomes of the differentiated educational practices on the results of grades in kindergarten classes need to be further

investigated.

A study by Senturk and Sari (2018) facilitated the contribution of differentiated instruction in scientific literacy. This study highlighted the teaching strategies and techniques used in the intervention process of this study, which consisted specifically of utilizing various studies in individualized instruction by Tomlinson (2016). The results concluded that differentiated instruction helps students engage in science, technology, society, and therefore the environment, develop skills within the scientific process, and improve their scientific understanding. The case study method was used in the qualitative research method. As a data collection tool, interviews with teachers and students, observations, and student diaries were managed. In this study, students improve their attitudes towards science education, learn science concepts, theories, and methods of research projects, read journals, books, and journals on science, and evaluate them in observations, research, and scientific activities. Moreover, during the differentiated learning-teaching process, students were found to own the development of scientific, technological, social, and environmental relationships and thus made significant progress toward the trail of science literacy.

Senturk and Sari (2018) aim to identify how this study affects the development of Grade IV pupils concerning the science track. The method of this case study among qualitative and quantitative was employed in the research. Science viewpoint scale and student diaries, interviews with students and teachers, and observations served as database tools. The study revealed a positive impact on the attitudes and interests of the pupils towards the science track. It was divulged that the pupils show willingness and enthusiasm and enjoyed differentiated instruction. Students who are not willing to science become more interested in it and are excited about what more it can offer through differentiated instruction. The control and experimental group's post-test scores of the attitude toward the course scale were compared significantly different was observed. Furthermore, the motivation, enjoyment, valuing, and self-confidence of the students were improved. Showing improvement and a positive attitude towards science courses are important because students will have high motivation level in achieving the course that would result in a positive academic achievement.

In the study by Alsalhi et al. (2021), they discussed how the varied instruction technique affected students' achievement and attitudes in an intermediate school course. The research was done in a semi-experimental manner. Some students were group into two: empiric and control. For their study, achievement exams and questionnaires were utilized as methods. The SPSS application was utilized to examine the data. It is showed in results that among the groups there were statistically significant distinction, with the experimental group guidance on DI being most beneficial. Positive feelings about the strategy were also revealed in the results. Their study suggests that differentiated teaching strategies be used when teaching scientific courses and other textbooks. It was concluded that based on the results, Differentiated Instructions (DI) allow students to cope with problems, issues, and difficulties well and simply because it became taken into consideration that it is modern, advanced, and effective techniques that hyperlink individual's uniqueness among the interests, abilities, attributes and various skills of the students. The significance of this study is to determine how authentic your strategy is, as well as how reliable it is in implementing students' advancement.

Brevik et al. (2018) emphasized a qualitative survey of student teachers' perceptions of differentiating high-performing junior high school students who are likely to learn. Taking into account her educational practices and experience, this study showed her perception of the application and value of differentiation. This research backs up the concept that, despite knowing how important differentiation is, student educators lack confidence in implementing it when working with these learners. Based on the results, student teachers will be given the opportunity to identify students and their individual needs and plan differentiated instruction for high-performing and adaptable students who are likely to succeed. It's easy to think that you need to.

During this time of the pandemic, doing research on a specific strategy is vital (Perez, et al., 2022). Teachers should find a remedy for how to deliver quality instruction in modular instruction (Cabello, 2022; Riconalla et al., 2022). At times, students procrastinate (Olleras et al., 2022) because of losing interest in the subject matter, especially Science. A differentiated instruction strategy can ignite the interest of the students to share their knowledge regarding the topic. However, during this time, parents are the ones accomplishing the tasks (Abucejo et al., 2022) of the students, especially the science activities in the module. If the students are having challenges in understanding science concepts, they can take advantage of the online resources if they have strong internet connectivity (Bahinting et al., 2022). Learners should continue learning even if the unprecedented

event – Coronavirus - hinders the quality of education being forwarded to them (Ando et al., 2022). This study can be a manifestation that there's always a way to deliver a topic in the most engaging way possible.

Students made better progress in a classroom when differentiated teaching methods were systematically used, in contrast to those students where there was no utilization of differentiated instruction approaches in a classroom. The socioeconomic situation cannot affect the student's performance, and the quality of individualized instruction had a corresponding effect on the student's performance (Abbey, 2021). Moreover, respondents get more knowledge if they take part in a classroom wherein differentiated instruction was being utilized, and also acquire knowledge of the teacher's application of the method. This can bring positive change in the classroom because respondents will be dealing with different instructions that were suited to their abilities and skills which in fact it increases their engagement in the class.

Hence, the works of literature involved in the study primarily pertains to the use of Differentiated Instruction, how it will be utilized in modern classrooms to establish meaningful experience and its positive impacts to the teaching-learning process. Additionally, in discussing Characteristics of solids, liquids and gas must be generally involved with the best strategies and variety of learning activities that will meet individual's needs. Through this strategy, a simple teaching-learning process will turn into an engaging, interesting and a cooperative one. This arouses students' interests and participation during the discussion of the characteristics of solids, liquids and gas. Therefore, it helps to establish meaningful learning experiences and brings positive changes that will pave way to a quality education afforded to the learners.

Methodology

This is quantitative research utilizing a quasi-experimental research design. This method is essential in pursuing action research wherein the goal is to test how effective a strategy is by selecting and choosing the respondents to be tested into two sets (the experimental and control group) arranged and controlled accordingly. Both groups will have a pre-test and a post-test. A traditional way of teaching the Characteristics of Solids, Liquids, and Gas will be utilized by the control group while the experimental group will utilize the strategy to be tested, which is a differentiated instruction.

Respondents

There will be 30 students from Grade 3 of the same section and will be grouped into two – the Controlled group (15 respondents) and the experimental group (15 respondents). The sampling will run for a week in discussing the Characteristics of Solids, Liquids, and Gas topic.

Plan Data Analysis

The study will use the Weighted Mean and Two-tailed T-test using the Statistics package for Social sciences (SPSS).

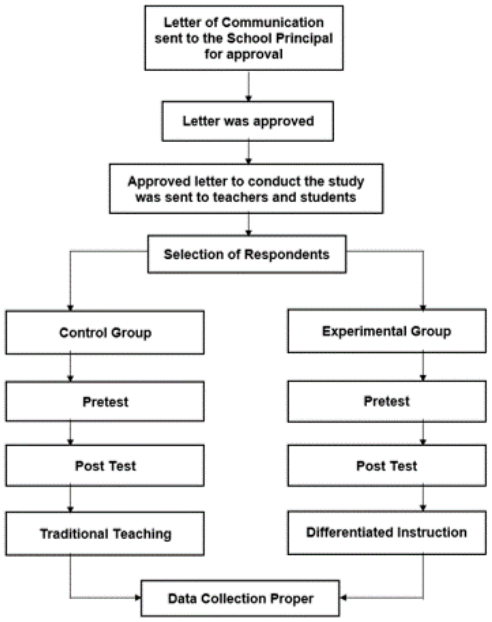
Weighted Mean. The weighted mean will be used to describe the pre-test and post-test results.

Two-tailed T-test. The two-tailed T-test is widely used in establishing critical points of a distribution area whether a sample is greater than or less than a certain range of values. This is also used in proving the acceptance and rejection of the null hypothesis. This can also be used in the different statistical analyses comparing two sets of values.

Procedures

A communication letter will be written and submitted for approval to the School Principal's Office. After the letter has been approved, the researcher notified for an invitation as the respondents in taking part in the study. The invitation is designed to be entirely voluntary, with no coercion or exchange of possible grade accommodations. The study's ethics will be strictly adhered to. The researcher will divide the respondents after receiving confirmation of agreement from the respondents. Each group had 15 pupils or respondents. Following that, the pre-test will be given. The researcher designed and constructed the pre-test, which was subjected to face validity and content validity (Cabello & Bonotan, 2020). The controlled group will use chalk and talk to learn the topic of Classifying objects and materials according to their properties and characteristics, whereas the experimental group will use differentiated instruction as a learning strategy. The administration of the post-test commenced. The researcher also created and designed the post-test, which went through the same process as the pre-test because their content is identical, the collected data will be subjected to the statistical tests specified in this study.

A flow chart was created to have a clear picture on how the gathering of data conducted.



Ethical Issues

The researchers observed ethical principles throughout the conduct of the study. The researchers maintained the highest level of objectivity in the discussions and analysis of findings throughout the study. Works of other authors utilized in this study in any part of the published articles and highly refereed journals with the use of APA referencing system was acknowledged. Prior to the study, the researchers provided an Informed Consent stating the study's aim and objectives to ensure that full permission from the respondents was obtained. According to Holland & Linvell (2019), respondents in the study were given an assurance about the protection of their personal information. This includes keeping the respondents to remain anonymous, securing participant's related privacy, and/or maintaining the confidentiality of information. The researcher also ensured that the gathered data from the respondents were given with the highest degree of anonymity. In the time of the conduct of this current study, the respondents weren't harmed nor abused, both physically and psychologically.

Results and Discussion

This part answered the research questions set in this study with discussions and substantiation from the different peer-reviewed articles.

Research Question #1

1. What is the pre-test result of the two groups of respondents?
   1.1 Controlled Group
   1.2 Experimental Group

Table 1. *Pretest Results of the Two Groups*

Respondents	*Pretest (Controlled Group)*	*Pretest (Experimental Group)*
1	13	19
2	17	9
3	15	20
4	9	16
5	9	13
6	11	15
7.	15	17
8.	9	19
9.	6	17
10.	15	16
11.	8	17
12.	12	12
13.	8	17
14.	15	18
15.	15	18
Mean	12	16
SD	3.45	2.93

Table no. 1 depicts the scores of both the control and experimental group. The result stipulated that the highest score garnered in the control group was 17 and the lowest score is 6 with an overall average of 12 and a standard deviation of 3.45. Meanwhile, the experimental group got 20 as their highest garnered score and 9 as their lowest with a mean and standard deviation of 16 and 2.93 respectively. The data being gathered depicts that most of the students of the control group got a below-average of 75% set by the Department of Education while the experimental group got an average of 75% set by the Department of Education.

Based on the outcomes of the two groups, this implies that the controlled group have a scarcity of knowledge and the experimental group have previous learnings about the characteristics of matter. The results of the study conducted by Marsha et al. (2015) that engaging students as active participants and creating proper elaboration about the topic in classroom discussions has great potential to promote student learning. According to Dong et al. (2020), previous knowledge is one of the most significant factors throughout teaching-learning process. Prior knowledge is also stated to help reduce cognitive load, resulting in good

learning performance.

The results of the two groups depicted that the controlled group have shallow knowledge and experimental group have profound understanding about the topic characteristics of matter. This can be a database to evaluate what kind of treatment we should utilize to answer this gap. It is pertinent to utilize various instructional approaches to effectively elaborate the topic. In this way, learners can understand and absorb the complex concepts which can help them concretize their understanding of the topic.

Research Question # 2

2. What is the post-test result of the two groups of respondents?
   2.1 Controlled Group
   2.2 Experimental Group

Table 2. *Posttest Results of the Two Groups*

Respondents	*Posttest (Controlled Group)*	*Posttest (Experimental Group)*
1	14	19
2	17	12
3	16	20
4	8	16
5	10	15
6	13	19
7.	15	18
8.	10	20
9.	12	20
10.	18	17
11.	16	18
12.	16	12
13.	16	18
14.	15	20
15.	15	20
Mean	14	18
SD	2.89	2.75

Table no. 2 provided data about the control and experimental group's score with the traditional way of teaching the topic and the differentiated instruction as a strategy. The data exhibit that the mean of the control group is 14 and its standard deviation is 2.89 with the highest score of 18 and its lowest score is 8. At the same time, the data of the experimental group presented that their highest score is 20 and their lowest score is 12 with the mean of 18 and 2.75 as their standard deviation. With this, it is observed that traditional method is less effective than using differentiated instruction.

The results showed that the experimental group using differentiated instruction increased student achievement than the controlled group using traditional way which imply that using differentiated instruction of the topic characteristics of solid, liquid and gas was effective. With this, Tomlinson (2004) as mentioned by Angilan (2021) reiterated that differentiated instruction is an intervention that is considered as an effective instrument in teaching to provide the student's different academic demands. This study exhibited that students' success and attitude academically improves when they are in the classrooms that are active and collaborative, hence considered as unique individuals with different styles of learning (Ryan & Cooper, 2007).

It can be perceived that the use of the new strategy had a huge difference to the one that utilized in the traditional way of teaching. With this, in the discussion of this topic, the new strategy did indicate a higher degree of learning towards the students which can be implied that there are strategies that can increase the performance of the learners. Teachers, as researchers, should discover all of these methods and strategies to be tested in different topics since, there's no best strategy at all.

Research Question #3

3. Is there a significant difference between the pre-test and post-test scores of the controlled and experimental groups?

Table 3. *Pretest and Posttest Difference between Controlled Group and Experimental Group*

Group	*n*	*df*	*t-value*	*p-value*	*Interpretation*	*Remarks*
Controlled Group	15	14	2.99	0.0098	Significant	Rejected the Null Hypothesis
Experimental Group	15	14	4.37	0.00065	Significant	

*Significance level is at $p < 0.05$

Table no. 3 displayed the interpreted data getting the difference of Pre-test and Post-test scores of the control and experimental group. The table highlighted that the scores of pre-test and post-test of the two groups are significant with 0.00 (as indicated in the p-value). This means that both groups are effective.

The table presented that the pretest scores of both

groups and their posttest scores signify meaningful difference. With this, it is being implied that as the students take the test without the proper knowledge have acquired the same level of understanding when they took the test utilizing both strategies – the traditional way and the new strategy. The table also provided an implication that in the manner of delivering the topic, the utilization of the new strategy which is the differentiated way of instruction shows students' different level of understanding. Students should be given learning opportunities that were already tailored to their desired learning style. Students can develop on their advantages and strengthen their deficiencies by knowing these learning preferences (Sener & Cokcaliskan, 2018).

In the study of Otte and Bentsen (2019), they highlighted that in discussing the topic, aside from strategy, other factors may interplay. The expertise of the teacher in delivering the topic with the use of the strategy may vary. With this, the result of having significance can be interpreted that the new strategy and the traditional way of discussing construe different impact of learning the subject matter.

Conclusion

In order to challenge the traditional way of teaching characteristics of solids, liquids, and gas among the grade 3 learners, a strategy called Differentiated Instruction was utilized. This study proved that this strategy established a significant difference. It may be necessary for the teacher to provide lectures at various degrees of complication depending of each student's aptitude as part of differentiated teaching, which aims to adapt the learning process to fit diverse learners, motivations, interests, and learning styles (Karatza, 2019). The topic is quite common and only a few dealt with the subject. Hence, there is limited information available. With this, it is recommended to have the strategy tested in another set of respondents for further validation.

Based on the findings this study found out that differentiated instruction established significant difference in classroom learning. And with this, for teachers who want to enhance their instruction but are hesitant to completely alter what they already do, the researchers recommend to use differentiated instruction as a teaching strategy since learners have different intellect and ways of learning. Teachers can apply and use the multiple intelligences using this strategy.

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