DIFFERENTIATED TEACHING STRATEGIES OF SELECTED TOPICS IN BIOLOGY

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ABSTRACT

Differentiated instruction has been gaining acknowledgment in different academic areas such as English and Mathematics. However, there were no studies that have been conducted about differentiated instruction in Biology, so, the researcher compared the effects of differentiated instruction and traditional method in teaching Biology. Using true experimental research design, the following results were obtained. The least mastered topics were: Cell Division, Genetics and Digestive System which were differentiated. The activities and lesson plans used in the differentiated group were tailored on their learning styles. The researcher used Percentage Frequency Distributions and Ranking Arithmetic Mean, Coefficient Variation, Standard Deviation, F test and Randomized Block Design using One Way Anova as statistical tools. A significant difference between the posttest and pretest scores of the two groups was identified. Differentiated group had greater achievement compared to traditional group. When categorized according to their learning styles, it was revealed that there was no significant difference in their post achievement scores. Lastly, a significant difference was found among the change scores of the differentiated group when categorized according to their learning styles. Findings revealed that using differentiated teaching strategies was effective in increasing the achievement level of students. In creating lesson plans and activities, congruency of the learning input in the learning styles of the students must be considered.

Keywords: achievement scores, differentiated teaching strategies, kinesthetic, learning styles, visual

INTRODUCTION

Education in the 21st century is far different from other centuries; it is dominated by various modalities. Though many centuries had passed, still the role of the teacher remains the same and that is to foster change. Teaching is not simply giving instructions, but it is more of using pedagogies of learning that will allow the students to maximize their full potentials in acquiring the knowledge and applying this knowledge. Teachers must also learn to adopt with the changes in the education, such as changes in the curriculum through continuous learning and discovering. In 2012, the biggest leap and major changes in our education system was marked and that was the implementation of K to 12 curriculum in the Philippines. The Philippines is among the three remaining countries in the world that still uses a 10 year basic education cycle, because of this it became a struggle for Filipino professionals to work abroad, since their educational qualifications was insufficient as compared to other countries with a 12 year basic education program, they are required to have a bridging course to close the said gap.

Based on the belief that the previous curriculum was no longer relevant to the needs of the students, as well as no longer capable of

meeting the global demands in education, thus the Basic Education Curriculum of 2002 was replaced by the K to 12 curriculum. The major shift in the curriculum is strongly felt mostly by science teachers who have been teaching their specialization for so many years, and as an educator it is a must to ensure that meaningful learning will transpire despite changes in the content and curriculum as well. It only means having deeper understanding of the topics and discovering strategies that will meet the needs of the diverse learners; tailored to the needs and capabilities of the learners as well as, and will produce learners who can meet the challenging demands of the society.

As the curriculum changes, it is expected that it will change achievement of students by increasing it. Biology as one of the areas of science is considered as one of the easiest subjects as compared to other field of science which entails mathematical skills but then different researches revealed that students fail to have a strong scientific foundation in Biology. Different studies have shown the poor performance of students in Biology.

In the Philippines, the poor performance of the students was evident in the results of National Achievement Test. For a long time, the students were not able to perform well at least in the satisfactory or average level, it is indeed a big disappointment, and a serious problem in our education system. Similar with the findings of Benito (2007), the poor performance of students in Biology was evident, based on the results of the National Achievement Test for the school year 2006-2007; it was revealed that more than half of high school students who took the exam achieved low mastery in learning competencies in each subject areas. Results showed that one out of five students seldom showed mastery in science. In terms of the percentage of students who gained mastery, science has lowest percentage of improvement. As seen from the results of the National Achievement Test for the school year 2005-2006, the following were the least mastered topics in Biology, this include, Genetics which focus on the different chromosomal aberrations, traits which follow the Mendelian principles and traits which do not follow the Mendelian patterns of inheritance. (Jala, 2009). Literatures revealed that students find it difficult to comprehend cell division and genetics. On a study conducted by Owiti (2011), he mentioned different factors which contribute to student's poor performance. One of them is failure of using appropriate teaching strategies in Biology. When teachers failed to choose the strategies suited for the learner and with the topic, poor achievement becomes evident.

Another challenge is the existing individual differences among the students which affects the teaching and learning process. Teachers should always be creative in terms of providing challenging activities that entails the curiosity and interests of the students. But in a traditional classroom, wherein a teacher uses one strategy for all learners, she failed in accommodating the individual differences that exist among the students. Now, how can a traditional teacher solve this problem? The researcher sees the solution in this problem, through differentiation.

Differentiation is a perspective and philosophy that molds the curriculum, planning, instruction, assessment, and classroom management (Arends and Kilcher,2010). Differentiation is based on the principles of individual differences among learners, the best learning modalities considering their learning preferences Incorporating differentiated instruction was considered as one of the significant approaches that must be used in classroom instructions under the new curriculum, which is K to 12. This was reflected in the Department of Education Memorandum 21 series of 2019,entitled Policy Guidelines of K to12 Basic Education Program, wherein it was stipulated that DepEd shall adhere with the following principles such as; the curriculum shall be learner centered that puts the needs and interests of the students at the center of the teaching and learning process. Another it was also stated that the curriculum shall use pedagogical approaches which includes differentiation. Thus, it only implies that differentiation has something to offer, it is quite tedious, it may not necessarily abruptly solve all the problems when it comes to instruction and

achievement, but probably it can provide solutions on how we make out students experience a meaningful learning, and develop a love for learning, because in a differentiated class, the main priority is what and how our students will learn best.

In this study, the effects of differentiated and traditional instruction in terms of increasing the achievement level of students in Biology was compared, as well as how the students' performance differ as they were grouped according to their learning styles.

OBJECTIVES OF THE STUDY

Specifically this study aimed to 1) identify the dominant learning styles of the students in the differentiated group; 2) assess the least mastered topics in Biology of Grade 8 students; 3) know if there is a significant difference between post and pretest achievement scores of the differentiated and traditional groups; 4) evaluate if there is a significant difference between the differentiated and traditional groups in terms of their post achievement scores 5) reveal if there is a significant difference among the post achievement scores of students in the differentiated group when they are categorized according to their learning styles and; 6) analyze if there is a difference among the change scores when they are categorized according to their learning styles.

MATERIALS AND METHODS

The study utilized the true experimental research design specifically the pretest and posttest equivalent design which shows the cause and effect and measuring any difference among the two groups before the treatment (Heffner, 2014). The participants in the study were two groups of Grade 8 students from Gen. Emilio Aguinaldo National High School (2015-2016) with thirty students each. Their Third Quarter Grades in Science were matched. Only regular students were included in the study. The fishbowl method was used to determine which among the two classes will be the control and experimental. To determine the learning styles of the students, the researcher administered a Learning Style Self-Assessment Questionnaire which was adapted from Clark (2005). The results of the inventory were used as a guide in creating activities that were used in the study. A 100-item achievement test was used as an item pool to determine which items which will be included in the final draft of 50 achievement test. The achievement test and the table of specifications were validated by three Biology experts using the Science Achievement Test by Gronlund (2003). To determine the language appropriateness of the test items, the clarity of the test instructions, the second draft of the achievement test was given to grade nine students. Then it was subjected to item analysis using Kuder Richardson 20 to determine the discrimination and difficulty index. Based from the results of item analysis, a 50-item achievement test were constructed by the researcher and Table of Specifications which were subjected to validation by three Biology experts. Their recommendations were all included in the final draft of the achievement test. Other instruments that were used in the study, were 30 item pretest and posttest, which consisted of the three least mastered topics in Biology, which were revealed by the 50 Item Achievement test, administered to grade 9 students. The 30-item pretest was used to determine the readiness level of the students. The questions came from the 50-item achievement test. A parallel set of posttests was prepared by the teacher which was used to measure if the students gained mastery after the treatment. The main instruments that were used by the researcher in the study were the differentiated and traditional lesson plans and differentiated and traditional activities. There were nine differentiated lesson plans and 25 differentiated activities prepared by the researcher. The lesson plans and activities were validated by three Biology experts using, Teacher's Checklist Performance Standard 4: Differentiating Instruction adapted from Barge (2012) and Lesson Plan Evaluation adapted from Hadley (2012). Nine traditional lesson plans and nine traditional activities were also prepared. These were validated by three Biology experts using Lesson Plan Evaluation adapted from Hadley (2012). The arithmetic mean, acceptability and agreement of

the differentiated and traditional lesson plans and activities were both measured.

During the pre-experimental phase, the preparation of the instruments and selection of the participants were made. The participants were selected based on their year level and third quarter grades in science. The second phase was the experimental phase, wherein various steps were undertaken by the researcher. A Learning Style Self -Assessment Questionnaire was administered to the experimental group to determine their learning styles. Then they were grouped according to their dominant learning style. The 50-item achievement test was administered to determine the three least mastered topics in biology which will be differentiated by the researcher. The differentiated and traditional lesson plans and activities were validated by three Biology experts. A 30-item pretest was given to both control and experimental groups. The researcher started the treatment, wherein the experimental group was taught through differentiated teaching strategies such as; learning centers, tiered assignment, Role, Audience, format, Topic, (RAFT), anchoring activities and cooperative learning. The control group was taught using the traditional method, wherein the teacher uses one strategy and focused on discussion. During the post experimental phase, data collection analysis and interpretation of data were accomplished by the researcher. The researcher used the following statistical treatments, and these were 1) Percentage Frequency Distributions and Ranking were 2) Arithmetic Mean 3) Coefficient Variation 4. Standard Deviation 5) F test and Randomized Block Design using One Way Anova.

RESULTS AND DISCUSSION

1. Dominant Learning Styles of the Students in the Experimental Group

Table 1 shows the results of the Learning Styles Self -Assessment Questionnaires, showed that 18 among the subject in the experimental group were visual learners which about 60%, 7 among the subjects in the experimental group were kinesthetic learners which about 23.3% and 5 were auditory learners which about 16.7%.

Table 1
Dominant Learning Styles in the Experimental Group

Learning Styles	Frequency	%
Visual	18	60
Kinesthetic	7	23.3
Auditory	5	16.7
Overall	**30**	**100**

The results of the learning style inventory is similar to the statement made by Dunn and Dunn as cited in Landrum and Mcduffie (2010), when they mentioned that normally the least preferred learning style is auditory which is 20 to 30 percent of the students while the most preferred learning style is visual which is about 40 percent. The remaining 30 percent to 40 percent are either kinesthetic or a combination of each learning styles.

2. Least mastered topics in Biology of Grade 8 students

Table 2
Least Mastered Topics in Biology

Topics	Total Number of Items (50)	Student's Average Score per Area (Based on Correct Answers)
Cell Division	10	22.80
Genetics	9	27.22
Digestive System	10	27.80
Biodiversity	11	27.82
Interactions	10	36.10

Table 2 gives information about the least mastered topics in Biology, the total number of items for each topic and the corresponding percentage of incorrect responses. The table also displays the student's average score per area; Cell Division at rank 1 which is 22.80, next Genetics which is 27.22, Digestive System at rank 3 which is 27.80, Biodiversity at rank 4 which is 27.82 and Interactions at rank 5 which is 36.

10. The three least mastered topics which are Cell Division, Genetics and Digestive System were taught by the teacher using traditional supported by Cimer, (2012) when he mentioned that cell division, genes and chromosomes are considered as two of the most difficult topics in Biology.

strategy for the control and differentiated strategies for the experimental. The findings are

3. Difference of the Post and Pretest of the Differentiated Group

Table 3
Repeated Measures ANOVA: Posttest vs. Pre-test Differentiated Group

Phase	f	Mean	SD	Mean Difference	F-value	Fcrt	df	p level	Remarks
Post	30	25.03	2.86	15.96	635.57	4.18	1.29	<.001	Significant
Pre	30	9.07	2.33						

Table 3 reveals the mean of the differentiated group during the pretest which is (9.07) and (25.03) during the posttest with a mean difference of (15.96). The performance of the group is heterogeneous during the pretest, as shown by its standard deviation with a value of (2.33). After the posttest, their performance was still heterogeneous as indicated by its standard deviation which is 2.86. It displays the computed F value which is 635.57, and the tabular value at df (1,29)= 4.18. The null hypothesis is rejected, it means that there is a significant difference between the posttest and pre–test of the differentiated group.

4. Difference of the Post and Pretest of the Traditional Group

Table 4
Repeated Measures ANOVA: Posttest vs. Pre-test: Traditional Group

	f	Mean	SD	Mean Difference	F-value	Fcrt	df	p level	Remarks
Post	30	18.4	4.63	9.80	112.49	4.18	1.29	<.001	Significant
Pre	30	8.6	2.76						

Table 4 reflects the mean of the traditional group during the pretest, which is 8.6 and 18.4 in the posttest, with a mean difference of 9.80. It displays the computed value of F which is 112.49 with a tabular value at df (1.29) = 4.18. With this value, it rejects the null hypothesis which means that there is a significant difference between the posttest and pre-test of the traditional group. Both groups display a significant increase in their post and pretest scores, but the differentiated group had a greater increase, with the computed value of F which is 635.57. This shows that, differentiated teaching strategies are more effective in increasing the achievement level of the students in Biology. The findings of the study were supported by Leonor (2014), when she pointed out that the use of differentiated science inquiry in teaching concepts in Chemistry had improved the understanding and mastery of the concepts in Chemistry. Beecher & Sweeny (2008), stressed in their study that differentiated instruction and enrichment were chosen as a strategy in increasing the achievement level of students. It was observed that learners in the differentiated group find enjoyment and excitement in every activity. Learners are not hesitant to ask questions and clarifications. It is supported by Beecher and Sweeny (2008), when

they mentioned that commitment in learning is being shown by the learners, when their interests, choices and learning experiences are tailored on the lesson.

5.Comparison of Posttest Scores of Differentiated and Experimental Groups

Table 5
Posttest Achievement Scores: Differentiated vs. Traditional

Treatment	f	Mean	SD	Mean Difference	F-value	Fcrt	df	p level	Remarks
Differentiated	30	25.03	2.86	6.63	44.608	4.02	1.55	<.001	Significant
Traditional	30	18.4	4.63						

Table 5 shows the mean of the differentiated group which is 25.03 which is higher as compared to the traditional group with a mean of 18.4. A mean difference of 6.63 was obtained. The computed F value which is 44.608 is higher as compared to the critical value of (1.55) = 4.02 p <.001. The null hypothesis is rejected, there is a significant difference between the posttest of the differentiated and traditional groups. The performances of the two groups differ significantly, in favor of the differentiated group. It implies that the treatment used in terms of increasing the achievement level of students in the experimental group is effective.

6. Analysis of the Posttest Scores of the Differentiated Group

Table 6
One Way Analysis of Variance Posttest of the Differentiated Group

Treatment	f	Mean	SD	F-value	Fcrt	df	p level	Remarks
Differentiated	30	25.03	2.86	0.265	5.49	2.27	<.001	Not Significant

Table 6 illustrates that the mean of the differentiated group during the posttest is 25.03. In terms of their computed F value which is 0.265 as compared with the tabular value df= (2.27), 5.49 is not significant. It means that there are no significant differences in terms of their achievement scores when they were categorized according to their learning styles. Achievement in the differentiated instruction is independent with the learning styles, which means that whether the students were visual, auditory and kinesthetic, they performed well under differentiated instruction and also implies that learning styles can be used with other teaching strategies.

6.1 Posttest and Pretest of Auditory Learners

Table 7
Summary of Change Scores: Posttest vs. Pretest of Auditory Learners

Test	N	Lowest Value	Highest Value	Mean	SD	Coefficient of Variation %
Pre-test	5	6	10	8.40	1.82	0.22
Posttest	5	23	28	25.40	2.07	8.16
Change		17	18	17.00	0.25	7.94

The mean gained among the three groups of learners in the experimental group were gathered and Table 7 present the summary of mean change scores from posttest to pretest of the auditory learners which shows a mean gained of (17) from posttest (25.40) to pretest (8.40).

6.2. Posttest and Pretest Scores of Kinesthetic Learners

Table 8
Summary of Change Scores: Posttest vs Pretest of Kinesthetic Learners

Test	N	Lowest Value	Highest Value	Mean	SD	Coefficient of Variation %
Pre-test	7	7	11	9.57	1.62	16.91
Posttest	7	21	29	25.43	2.7	10.61
Change		14	18	15.85	1.08	-6.3

The mean gained among the kinesthetic learners were being calculated and Table 8 exhibits the summary of mean change scores of kinesthetic learners of their pretest and posttest which is (15.85) from posttest which is (25.43) to pretest (9.57).

7. Posttest and Pretest Scores of Visual Learners

Table 9
Summary of Change Scores: Posttest vs. Pretest of Visual Learners

Test	N	Lowest Value	Highest Value	Mean	SD	Coefficient of Variation %
Pre-test	18	4	13	9.06	2.71	29.94
Posttest	18	19	29	24.78	3.19	12.88
Change		15	16	15.72	0.48	-17.06

Table 9 display the summary of mean change of the visual learners of their pretest and posttest which shows a mean gain of (15.72) from posttest of (24.78) to pretest of (9.06). Among the three groups of learners, the auditory learners have the highest mean gained which is (17), compared to kinesthetic which is (15.85) and visual which is (15.72). With these data, these reject the null hypothesis, which means to say that there are significant differences between the change scores of the subject when they are categorized according to their learning styles. It implies that, after being exposed to differentiated teaching strategies, they were able to learn the concepts well as shown by the increase in their mean scores and standard deviation.

Indeed, it is evident that the use of differentiated teaching strategies can increase the achievement level of students in Biology. As a teacher differentiates her instruction, she can consider the learning styles of the students. In a way that all the activities and tasks are aligned in their learning styles, their learning styles can be used to initiate or can be used to accomplish the tasks of a particular topic. Based on the results of the study, when the learning styles of the students were tapped, they performed well in terms of their achievement scores.

CONCLUSIONS

Based on the foregoing results, the following conclusions were drawn;

1.Differentiated teaching strategies has significant difference compared with traditional method of teaching, which is evident in the results of their posttest,

2. There is no significant difference in the posttest scores of the differentiated group when they were categorized according to their learning styles

3. It was revealed that in differentiated instruction, if the learning input is congruent in their learning styles there is no significant difference in the performance of auditory, visual, and kinesthetic learners. 4) In terms of their change scores, auditory has the highest change scores compared to visual, auditory, and kinesthetic. In this study, it indicates that all learners had an improvement in terms of their change scores, but auditory learners had a greater improvement as compared with the other learner.

RECOMMENDATIONS

Considering the findings of the study, the following recommendations are offered for considerations;

1.Use differentiated teaching strategies to investigate its effect on the achievement of students in other subject areas such as Social Studies, Physical Education and Filipino.

2.Consider learning styles of the students before deciding and applying teaching strategies,

3.Enhance teaching modalities using differentiated teaching strategies from one another.

4. Administer a readiness test among the experimental activities with the various learning styles needed by the learners.

5.Compare the effectiveness of various group before differentiating instruction for future study.

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Riza Mae S. Sanchez, is currently taking her Doctor of Philosophy in Science Education at Philippine Normal University Manila. She finished her Master of Arts in Science Education, Major in Biology, at Philippine Normal University in 2016 and obtained her Bachelor of Secondary Education in Biology, at the same university, where she graduated Cum Laude. She is a resource speaker and demonstration teacher in different trainings and seminar. Recently, she was adjudged as an outstanding workshop presenter during the National Conference in Biology held at Philippine Normal University. She is also a winning coach of researchers of senior high school during the National Conference held at De la Salle University and Trece Martirez City last March 2019 and April 2019. She has been an oral paper presenter in the different national research conferences here in the Philippines. She was also chosen by Philippine Normal University to be one of the delegates and present the research paper in the International Postgraduate Roundtable Research Forum which was held at Education University of Hong Kong last July 3-5, 2019. Presently, she is a Master Teacher II and the subject group head of STEM Department in Luis Y Ferrer Jr. Senior High School.

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