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5E GUIDED INQUIRY MODEL AND STUDENTS' ATTITUDE AND ACHIEVEMENT IN ALGEBRAIC EXPRESSIONS

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Many students are struggling to learn the concept of algebraic expressions due to poor understanding of how to perform mathematical operations. A 5E guided inquiry model is one of the teaching strategies utilized to support students think and work mathematically. Hence, this study was conducted to examine the effect of 5E Guided Inquiry Model on the achievement of grade 7 students in algebraic expressions. Two intact classes composed of twenty four (24) students each were used as sample assigned to groups based on their first grading grade in Mathematics 7. Control group was taught using traditional strategy while the experimental group was taught using 5E guided inquiry model. Quasi-experimental approach was employed using one-shot experimental design with pretest-posttest instrument used to collect data. Results showed that both student participants under control and experimental group have the positive attitude towards mathematics. This expresses comparable affective aspect among students when they both underwent the model used in this study. The attitude of student participants is not significantly related to their achievement in algebraic expressions. In addition, the achievement in algebraic expressions of students exposed to 5E guided inquiry model significantly higher compared to the achievement of students exposed to traditional strategy. Hence, teaching algebraic expressions with the aid of 5E Guided Inquiry Model gives a positive impact on students' academic achievement.

Keywords: 5E Guided Inquiry Model, Grade 7 students, algebraic expressions, Quasi experimental design

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1. INTRODUCTION

Studying the concept of mathematics is a challenging task for most students. The primary requirement to the success of mathematics education is the clear understanding of how really a learner learns the best way (Costillas, 2004; Costillas, 2016). In the K-12 Curriculum for Mathematics (Department of Education, 2012), it is highlighted that the twin goals of mathematics in basic education levels is to develop critical thinking skills and problem solving skills (Costillas, 2015b). However, sad to note that when concern is expressed about attainment of these goals, mathematics is usually singled out as being a particularly worrying problem. It cannot be denied that mathematics plays a crucial role in one's life but the reality is that majority of students find it difficult to acquire the different mathematical processes useful in their everyday lives (Casinillo, 2019). Perhaps, some students view mathematics as their waterloo, hence students perform poorly in mathematics. Filipino students excel on knowledge acquisition but fare considerably low on lesson requiring higher order thinking skills (Andaya, 2014). Asking questions and searching for the concepts became less prone to students as they move from grade to grade. According to Collier (2015) memorization of facts is not anymore an important skill in today's world because facts change. What a learner needs is how to understand and how to search things from unknown to known. The quality of instruction and effective instructional design are very necessary to alleviate problems related to teaching and learning mathematics (Samuelsson, 2008)

However, it is clear that when concepts are not meaningfully understood by students, they tend to shy away from questions set on them during National Achievement Test or NAT (Hodge, 2008). The current NAT result of Libhu National High School showed a decrease in Mean Percentage Score or MPS of 53.06% which is far from the target rate of at least 75%. Decrease in mathematics achievement has been partly ascribed to teacher-related factors such as inadequate teaching and instructional approaches adopted in teaching-learning process (Tseng et al., 2013). It is vital for the teacher to provide a bridge between the unfamiliar concepts and the knowledge which students already have (Lynn, 2012). This is where the concept of inquiry-based learning comes in – teaching the learners how to learn not what to learn. In this context, an important factor for an effective learning process to develop is enhancing maximum engagement for all learners in the inquiry learning activities.

Inquiry-based instruction seems to be the right approach that can help increase achievement considering grade 7 as a foundational level to mathematics

learning in the secondary education. Hence, this study is conceived. The focus of student ownership and investigation is essential in defining the inquiry instructional model in a context of mathematics classroom. In extending the concept of inquiry to a mathematics, students are expected to develop an understanding of traditional math rules in a conceptual light (Gardner, 2012). Students can do this through group work and solving problems that require the application of various skills, rooted in application to the real world (Timothy, 2010). The goals of inquiry-based models such as the 5E are to focus on active engagement by students as well as an exposure to higher level mathematical thinking. The National Council of Teachers of Mathematics (NCTM) has used the fundamental concepts of inquiry to introduce process strands used for all grade levels: problem solving, reasoning and proof, communications, connections and representation. This structure suggest that the typical math classroom should make room for students to explain their thinking and reasoning to their classmates on a daily basis (Johnson & Norris, 2006).

Wheeler and Bell (2012) stated that while many components of inquiry in mathematics mirror the use of inquiry in other content areas, specific requirements arise as a result of the nature of mathematics. These differences relate specifically to the questions or problems students are attempting to solve and how solutions are expressed. In mathematics classrooms, inquiry-based questions can also arise in abstract constructions such as numbers, shapes and algebraic structures (Schäfer, 2019). As students navigate questions arising from real-life, it is also important to ensure that the questions being asked are solvable within the realm of mathematics. This way, students can use the process of modeling that is specific to mathematics. Students may then make connection between the solution generated in the model and more complex scenarios in the real world.

The 5E guided-inquiry model stand for *engage, explore, explain, elaborate, and evaluate* (Bybee, 2009). The 5E guided inquiry model is an instructional framework which develops the learning process through inquiry-based approach using learning cycle called 5Es (Bybee et al., 2006; Tural et al., 2010). This is the most practical model in the constructivist pedagogical approach as it enables students to analyze and synthesize new information in the constructivist classroom. The concept of Guided Inquiry according to Kellow (2006) is an approach that seeks to scaffold students at the points in the information search process where they cannot proceed without difficulty. Kuhlthau (2010) explained the twin purposes of Guided Inquiry which include: guiding student inquiry and evidence -based practice. One lesson-planning template that could be used when

planning a guided-inquiry lesson is the "5E" model. Roger Bybee et al. (2006). The 5Es represent five stages of a sequence for teaching and learning: *Engage*, *Explore*, *Explain, Elaborate* and *Evaluate*. Origins of the 5E Model can be traced to the philosophy and psychology of the early 20th century and Johann Herbart (1841), a philosopher. His psychology of learning can be synthesized into an instructional model that begins with students' current knowledge and their new ideas that relate to the current knowledge. According to Herbart (1841), the best pedagogy allows students to discover relationships among their experiences. Ramlee et al. (2019), and Wilke and Straits (2005) emphasized that the question and the experiment are provided as a framework in which the student may do the exploring. This is done to help expedite the process and to keep students on track with respect to mathematics standards. However, teachers most often structure the activity so that these standards are being met. Students have more independence. Working from an assigned set of appropriate resources, students determine for themselves which resources they will explore to answer the essential questions. In the 5E model, students bring their learning back to the group to share in the Explain section.

The teacher helps to make sure their understandings are clarified. Each lesson includes suggestions to help teachers model. Guided Inquiry for students who are new to the process but who nevertheless have the necessary skills to succeed (Kuhltau, 2007; Bybee et al., 2006). 5E guided inquiry model according to Wilson et al. (2006) and Bybee (2009) is a sequence of learning experiences so that students have the opportunity to construct their understanding of a concept over time. Students are involved in more than listening and reading. They are developing skills, analyzing and evaluating evidence, experiencing and discussing, and talking to their peers about their own understanding. Students work collaboratively with others to solve problems and plan investigations. Tinio (2009) said that any students find that they learn better when they work with others in a collaborative environment than when they work alone in a competitive environment. This is supported by Yerrick et al. (2003) and Yilmaz (2010) that when collaborative learning is directed toward inquiry, students succeed in making their own discoveries.

Although Inquiry-based approach worked out effectively in previous science researches (Pine, 2006; Crawford, 2007), but the practice of inquiry-based instruction has been of little emphasis in mathematics classrooms (Gardner, 2012; Rooney, 2012). Additionally, from ten randomly selected mathematics teachers of Maasin City Division, only less than half of them are closely familiar about the 5E Guided Inquiry Model. This entails that teachers are not that frequently employing

inquiry-based approaches in mathematics teaching. In addition, in the current data from the office of Maasin City Division, Libhu National High School has obtained an overall Mean Percentage Score (MPS) of 53.06% during the current National Achievement Test (NAT) 2015. It is 14th in over-all ranking among all secondary schools in Maasin City Division. Its MPS in mathematics is 55.41% which dramatically decreased from previous results 84.67% (2014), 83.67% (2013) and 81.49% (2012). Thus, the study is realized.

Research Questions

This study investigates the effectiveness of 5E Guided Inquiry Model on mathematics achievement of grade 7 learners. More specifically, this study sought answers to the following questions:

1. What is the level of attitude of students towards mathematics before the experiment?
2. What is the level of students' achievement in algebraic expressions before and after exposure to the 5E Guided Inquiry model and traditional model?
3. Is there a significant relationship between students' achievement in algebraic expression and their attitude towards mathematics before the experiment?
4. Is there a significant increase in the achievement of students from pre-test to post-test for both control and experimental group?
5. Is there a significant difference on the level of posttest achievement between the students exposed (experimental) and not exposed (control) to 5E Guided Inquiry Model?

2. METHODOLOGY

Research Design

This study used the quasi-experimental design which test causal hypotheses (White & Sabarwal, 2014). Specifically, the study adopted the pretest-posttest design based on the current paper by Yunzal and Casinillo (2020). This study utilized equivalent intact classes which were identified as experimental and control groups in advance. These two intact classes were selected and assigned to

experimental group and control group using their first grading grade in Mathematics 7. The research design is diagrammed as follows:

G_1 : O_1 ---------- **X** ---------- O_2
G_2 : O_3 ---------- O_4

Figure 1. Quasi-experimental design

In the figure, G_1 and G_2 are the experimental and control group respectively. The two groups were given a pretest and a posttest. The symbol X represented the experimental treatment that is given to G_1. The symbols O_1 and O_3 represented the pretest, which were given to the two groups before the actual use of 5E Guided Inquiry model and the traditional method, respectively. On the other hand the symbols O_2 and O_4 represented the posttests given after the experiment.

Research Participants and Locale of the Study

The population of this study was composed of 107 grade 7 junior high school students, 68 boys and 39 girls who are enrolled in Libhu National High School as of school year 2015-2016. From the three sections of the grade 7 level, the study utilized only two sections or intact classes as samples. These two sections were Gomez (experimental group) and Zamora (control group). Both sections have 35 students (consisting both male and female) and from 35 only 24 or 69% were taken as a sample based on their grade in Mathematics 7 during the first grading period. The experimental group composed of 24 students were exposed to 5E guided inquiry teaching model while the control group, also 24 students were exposed to the traditional model of teaching. It is worth noting that this research study was purely academic in nature and no sensitive data was gathered. In addition, the participation of students in this study was voluntary. Table 1 reflects the distribution of respondents by group indicating the population and sample.

Table 1. Distribution of Respondents by Group

Group	Population	Sample	Percentage (%)
Experimental	35	24	69
Control	35	24	69

During the sampling of respondents, the grades of students in Mathematics 7 during the first grading period were utilized in order to determine the proportion of students for experimental and control group. The mean grade of each class was computed. The names that belong to the above and below the mean were identified by forming four groups of six members. However, the identified names were equally distributed so that each group in an intact class contains learners of all types (whether fast, average or slow ones). With the grades obtained from report cards week after the first quarterly assessment, the students were more or less comparable in ability in mathematics. Complete enumeration was not applied in order to keep the internal validity of the study considering the threat of absences among students in their attendance. This study assured that these equivalent samples of 24 respondents from both groups completed their attendance during the period of experiment. Table 2 shows the distribution of the first grading Mathematics 7 grades of respondents in experimental and control group. As presented, in control group the highest grade obtained is 89 and the lowest grade is 78 with a mean grade of 83.88. On the other hand, the experimental group has the highest grade of 90 and lowest grade of 78 with a mean grade of 83.79. The standard deviation of the experimental group is 2.88 while the control group is 3.18.

Table 2. The Distribution of Mathematics 7 Grades in the First Grading Period of the Students from both Control and Experimental Groups

Respondents	Highest Grade	Lowest Grade	Mean	Standard Deviation
Control	89	78	83.88	3.18
Experimental	90	78	83.79	2.88

Research Instruments

A Pretest/Posttest Achievement Questionnaire was developed and used for data gathering. This is a 20-item multiple choice questionnaire administered to both groups, the control and experimental. Basically, the instrument was designed to measure the level of achievement of the students in algebraic expressions before and after exposure to the teaching models used. This test was in line with the lesson plans and covered the competencies involved in the experiment. Content mostly focused on 3rd Quarter topics in Mathematics 7 which are all about algebraic expressions. However, only the instructional approach differs but the

content for both groups is the same. Questions however were carefully taken from standardized materials: California Standard Test-Algebra I and North Carolina End-of-Grade-Assessment-Math 7 (2013). Although taken from international sources the instrument followed a protocol on testing and content validation since a different setting was observed. For critiquing and content validation, three mathematics experts, holding Masters Degrees convened to validate items. Strict adherence to test blueprint was observed. Checking the congruence of item with the table of specification (TOS) and rating the extent of agreement via content validation sheet adopted from Costillas (2008) were done. So far, all concerned experts agreed on the content validity. Since the questionnaire is already valid in content, no revisions or amendments were made. The pretest and posttest scores were the prime basis of assessing achievement in algebraic expressions of respondents. The qualitative label for every interval of scores in Table 3 was based on DepEd (Philippines) Order No. 8 series of 2015.

Table 3. Possible scores and its corresponding level of achievement

Scores	**Level of Achievement**
17 – 20	Outstanding
13 – 16	Very satisfactory
9 – 12	Satisfactory
5 – 8	Fairly satisfactory
1 – 4	Did not meet the expectations

Aiken Revised Math Attitude Scale

To determine the attitude level of respondent towards mathematics before the start of the experiment, this study used a Likert type inventory called Aiken Revised Math Attitude Scale originally developed by Aiken (1974). The instrument measures the students' enjoyment of the subject and it is already validated by Aiken (1974). This is composed of 20 questions and was used in the study of Raagas (2009) covering both positive and negative statements. On the note, attitude scores served as moderating filter not precisely taken as one major variable to the experiment involved. A modal score obtained by each participant were categorized as to the following scheme by Kalder and Lesik (2011) shown in Table 4.

Table 4. Possible scores and its corresponding level of attitude towards mathematics

Score	Level of Attitude
5	Very Positive
4	Positive
3	Neutral
2	Negative
1	Very negative

Lesson Plans

This study utilized Lesson Plans (LPs) personally developed by the researcher. LPs were in two forms: the one that used the 5E Guided Inquiry Model while the other one applied the traditional model. The way lesson plans were developed using the 5E Guided Inquiry Model were based upon the study's theoretical framework as well as literature reviews on 5E, Guided Inquiry Approach and Inquiry-Based Learning (IBL). The lesson procedure followed the five stages of 5E learning cycle by Roger Bybee (2009) namely *Engagement, Exploration, Explanation, Elaboration, Evaluation*. The different cooperative learning tasks or activities were designed following the theory of guided inquiry wherein students are basically facilitated in the information search process through meaningful tasks that allow them to construct and discuss meaning of concepts. Activities and formative assessments were patterned from specified references and online sources. Ten lesson plans on 5E Guided Inquiry Model were written containing concepts of module 3 under the new mathematics curriculum which were mostly about basic algebraic concepts for grade 7. The lesson plans lasted for eighteen (18) sessions. The lesson plans were consulted to the school head just simply to ensure if they coincide the intended framework. For the traditional model, lessons were the same except the framework of 5E Guided Inquiry Model. Hence, the teacher discussed the lesson in a usual way and give the learning tasks or activities after. Furthermore, critiquing is important to ensure if the development of the lessons showed congruence with the desired learning competencies involved in the study.

Research Procedure

Prior to the start of study, the researcher formally secured permission from the principal of Libhu National High School with an approval from the division office. Selection of two intact classes experimental and control groups were identified as participants of experiment following the right protocol of sampling. From 35, only 24 or 69% were drawn as samples in order not to be affected by the threat of absences. This size was the subject of the interventions employed namely, 5E Guided Inquiry Model for experimental group and Traditional Model for control group. Week before the start of study, the student participants were met by the researcher in order to inform them about the nature of experiment and its sole purpose. Pre-test inventories were made day after the orientation. A 6-week instruction followed on dates as specified in the LPs used including time schedules. Over a period of five (5) weeks were used to complete the implementation. However, in order to maintain a clear distinction between the two groups, adherence to the instructional framework was strictly observed. Likewise, the lesson plans and instructional materials were prepared ahead of time to ensure validity of results. In addition, to minimize the bias in this quasi-experimental design, the conduct of the study was observed and monitored by the research (thesis) adviser. Documentation was also made to ascertain if plans purport the framework. After the duration of experiment, the groups underwent posttest as culmination of the whole activity. Same time (2 hours) with pretest was provided for participants and made sure same instructions were understood by them clearly. After the conduct of posttest, the data derived from the tests before and after the study was made were recorded, tabulated, given statistical treatment and analysis using the prescribed statistical tools in order to generate meaningful figures as basis for discussion of findings and eventually test the null hypotheses.

Data Analysis

For the data management of this study, the researchers used Frequency Count and Percentages, Mean, and Mode as descriptive statistical treatment to interpret the data gathered from the survey. Chi-square test for independence was used to find relationship between two variables. In this case, the data in the cells are frequencies and the categories of the two variables are mutually exclusive, hence, Chi-square test for independence is the appropriate test. In addition, Paired t-test and Independent t-test was employed to compare the two mean scores after the implementation of 5E guided learning model. T-test was used since the data

are interval scale in nature and it was gathered by random sampling procedure. To ensure a correct calculation of statistical results, data analysis had been performed using Statistical Package for Social Sciences (SPSS).

3. RESULTS AND DISCUSSION

Attitude of Students before the Experiment

Table 5 gives the distribution of attitude scores of respondents. The frequency and percentage of students whose attitude scores fall for every category are reflected. Data reveals that the control group shows "Positive" level of attitude (*Mo*=4) while the experimental group also manifested "Positive" attitude (*Mo*=4). This implies that both groups of student participants have positive attitude towards mathematics. It can also be observed that most of the students' attitude scores fall at the "Positive" level in control group (13 or 54%) and experimental group (17 or 71%). This also expresses comparable affective aspect among students when they underwent both models used in the study. Sarouphim and Chartouny (2017) reported that studies have shown that positive attitudes are conducive to good achievement. According to Yara (2009), students' positive attitude towards mathematics is enhanced by teacher-related factors such as teachers' resourcefulness, thorough knowledge of the subject-matter and making mathematics quite interesting. This connects as well the study of Tinio (2009) which reveal how necessary the behavioral or attitude scales to measure academic engagement. It is essential to construct them because it could be an avenue of improving the education of a student. Casinillo et al. (2020) asserted that students' affective dispositions such as attitude are predictors of students' subsequent behavior hence should develop positive concepts of themselves so they would become more interested in the subject they study. Moreover, a student can develop positive attitude towards mathematics because he or she learns to associate positive experiences or events with it. Also, positive reinforcement creates room for the formation of positive attitude for mathematics (Casinillo & Casinillo, 2020).

Table 5. Level of attitude of students towards Mathematics

Level of Students' Attitude	Control		Experimental	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Very Positive	0	0.00	0	0.00
Positive	13	54.16	17	70.83
Neutral	11	45.83	7	29.17
Negative	0	0.00	0	0.00
Very Negative	0	0.00	0	0.00
Total	24	100.00	24	100.00
Modal Value (*Mo*)	**4**		**4**	
Overall Description (a)	***Positive***		***Positive***	

Note: a – See table 4 for details.

Students' Achievement in Algebraic Expressions Before and After Exposure to 5E Guided Inquiry Model and Traditional Model

Reflected in Table 6 is the frequency of respondents for each qualitative label. As observed, the control group performed at "Fairly Satisfactory" level ($\bar{x}$=6.64, sd=1.865) while the experimental group also performed at "Fairly Satisfactory" level ($\bar{x}$=7.04, sd= 2.053). Notice that both groups started with the same level of learning due to the low scores that mostly fall at this level for control group (18 or 75%) and experimental group (16 or 67%). This indicates that both groups are comparable in terms of ability although the experimental group (sd=2.053) has a more scattered data or scores compared to the control group (sd=1.865). This adheres the result of Yunzal and Casinillo (2020) which observed relatively equal pretest achievement. Kuhlthau (2007) opined that students' relative background is basically prerequisite for a lesson to lesson transition. Moreover, the study of Akuma (2007) affirms the results as equal level of achievement yield on the pretest scores of 40 students taught with guided inquiry and lecture method.

Table 6. Achievement of the students in algebraic expressions before exposure to Traditional and 5E Guided Inquiry Model

Achievement of Students	Control		Experimental	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Did not Meet the Expectation	3	12.50	3	12.50
Fairly Satisfactory	18	75.00	16	66.67
Satisfactory	3	12.50	5	20.83
Very Satisfactory	0	0.00	0	0.00
Outstanding	0	0.00	0	0.00
Total	24	100.00	24	100.00
Mean score ($\bar{x}$)	**6.54**		**7.04**	
Standard Deviation (*sd*)	1.865		2.053	
Overall Description (b)	***Fairly Satisfactory***		***Fairly Satisfactory***	

Note: b – See table 3 for details.

Table 7 reflects the achievement in algebraic expressions of the participants after the experiment based on the actual posttest scores. Participants in the control group performed at "Satisfactory" level ($\bar{x}$=10.63) while the experimental group performed at "Very Satisfactory" level ($\bar{x}$=15.13). Data values showed almost closer amount of dispersion for both groups (*sd*=2.568 vs. *sd*=2.675) which conforms the frequency of scores which are scattered or spread out. Since both groups yield increase in the mean values from pretest to posttest, it shows clearly that students of control group (6.54 to 10.63) and experimental group (7.04 to 15.13) performed well with the teaching models used. A closer look at data values shows that although both groups made an increase, the mean gain in experimental group is higher than control group (8pts. vs. 4pts.). Higher gain in scores for experimental group than control group reflects 5E Guided inquiry model as a better approach than traditional. This is supported by the findings of Mathew and Kenneth (2013) regarding the effects of guided inquiry on achievement in logic. Pretest to posttest scores revealed higher achievement in experimental than control group. The study of Bell and colleagues (2005) also found students gained skills after modeling inquiry in the class and contribute to a better understanding of content as well as active thinking and discourse in contextual setting. In the area of investigating the heterogeneous student's participation in inquiry activity, research shows lower track students can enhance their argumentation in open-inquiry (Wilson et al., 2010) while high ability

students can enhance inquiry skills in conducting inquiry research (Bell et al., 2005).

Table 7. Achievement of the students after exposure to Traditional and 5E Guided Inquiry Model

Achievement of Students	Control		Experimental	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Did not Meet the Expectation	0	0.00	0	0.00
Fairly Satisfactory	4	16.66	0	0.00
Satisfactory	15	62.50	3	12.50
Very Satisfactory	4	16.66	11	45.83
Outstanding	1	4.17	10	41.66
Total	24	100%	24	100%
Mean score ($\bar{x}$)	**10.63**		**15.13**	
Standard Deviation (sd)	2.568		2.675	
Overall Description (b)	***Satisfactory***		***Very Satisfactory***	

Note: b – See table 3 for details.

Relationship between Achievement in Algebraic Expressions and Attitude towards Mathematics

Calculated values through chi-square as presented in Table 8 reveal that there is no significant relationship between attitude and the achievement in algebraic expressions both in control group (χ^2=0.238, p-value=0.826) and experimental group (χ^2=0.554, p-value=0.457). This implies that attitude is not significantly related to the achievement of students in algebraic expressions. This further tells that attitude was never a factor that affected the increase or decrease of scores in the pretest. In other words, attitude has no bearing on models employed. This finding is similar to the study of Raagas (2009) which concluded that attitude towards mathematics does not significantly affect the achievement of students. Korir (2014) also adheres this finding after his study on the influence of students' attitude on achievement in chemistry revealed no significant relationship between these variables. Casinillo and colleagues (2020) describe attitude and achievement relationship indefinite. He added that being merely aware of an individual's attitude towards a subject is a weak predictor of his subsequent achievement. Likewise, the study of Sirmaci (2010) gives support to the findings when arriving weak correlation between achievement in algebra and attitudes of students.

Table 8. Relationship between achievement in algebraic expressions and attitude towards mathematics

Groups	Variables Tested	Test Used	χ^2	p-value	Interpretation
Control Group	Pretest Achievement and Attitude Pretest	Chi-square	0.238^{ns}	0.826	No relationship
Experimental Group			0.554^{ns}	0.457	No relationship

Note: ns – not significant.

Significant Increase of Students' Achievement in Algebraic Expressions from Pre-test to Post-Test

Table 9 illustrates the results of the test measuring the significance of increase in the mean scores from pretest to posttest of students exposed to the models. Data were derived using Paired t-test. As gleaned, students under 5E Guided Inquiry Model marked a highly significant increase (t=29.36, df=23, p-value<0.001) in the achievement in algebraic expressions. Similarly, the student participants exposed to traditional approach also yields highly significant increase (t=10.36, df=23, p-value<0.001) in achievement. Notice that the data showed relatively equal p-values for both models which imply that both has improved significantly the achievement of the students in algebraic expressions. This concur the result of Costillas (2015a) which revealed the same significance values for both groups. This means that there is still a reason to use traditional methods in teaching algebraic expressions. However, it can be noticed that there is a certain gap in mean increase between groups as shown by higher mean difference in experimental group than control group (8.083 vs. 4.083). This implies that students exposed to 5E guided inquiry model perform better than traditional approach. Furthermore, the control group from pretest to post test is still far apart from the perfect score (20 points) which means that there is still much needed to improve achievement, and 5E Guided Inquiry model is seen to help attain this goal. Consonant to this finding is the study of Banerjee (2010) whose results in his study about inquiry methods in science indicated higher increase in scores in experimental group than control group. The finding is affirmed by the study of Olufunke (2015) on relative effectiveness of Learning Cycle Approach (LCA) and Inquiry teaching Approaches (ITA) in physics which revealed significantly better achievement of students exposed to the two approaches than those who are not.

Likewise, the same results corroborated the studies of Akuma (2007) and Ferguson (2010) whose findings drew significant increases in achievement when inquiry teaching approaches are applied in classrooms. This as well affirms the statement of Ramlee et al., (2019) that guided inquiry method helps increase students interest, problem solving ability and improves their achievement in both theory and practice.

Table 9. Significant increase in the mean scores of students exposed to 5E Guided Inquiry Model and Traditional Model

Tests Compared	Paired Differences		t	df	Sig. (1-tailed) *p-value*
	Mean	Std. Deviation			
Pretest Control Group - Posttest Control Group	4.083**	1.932	10.36	23	<0.001
Pretest Experimental Group - Posttest Experimental Group	8.083**	1.349	29.36	23	<0.001

Note: **-highly significant at 1% level.

Significant difference of the students' achievement between control and experimental group

Table 10 reveals the computed values of the t-test analysis with the assumption of equal variances after testing homogeneity of variance through Levene's test. It can be observed that there is a highly significant difference (t=5.954, df=46, *p*-value<0.001) in achievement between students from both teaching models. This implies that students exposed to 5E guided inquiry model differ significantly with students exposed to traditional model. Due to higher mean in experimental ($\bar{x}$=15.13) than control group ($\bar{x}$=10.63), this difference favors the inquiry model. This shows that 5E guided inquiry model gives stronger impact on achievement than traditional approach ($\bar{x}$-difference=4.5). Findings also imply that students in guided inquiry classroom yield better achievement, hence more effective than traditional. This result provides support for the efficacy of 5E guided inquiry instruction for mathematics as claimed by the researchers Gardner (2012) and Rooney (2011). This as well adheres the study of Matthew (2013) which tested the same hypothesis and showed that students taught with traditional methods differed significantly in favor of students taught with guided inquiry approach. Ferguson (2010) also affirms that student's cognitive achievement is better when taught with inquiry model. This also agrees the findings made by Duran and Duran (2004) that inquiry approaches develop better understanding of content.

This confirms the statement of Ramlee et al (2019) that learning lasts when connection between mathematics classroom and outside experiences is developed. Findings also made connection with the research work of Enugu and Hokayem (2017) on 5E model which made to confirm that 5E model effectively addresses learning needs of students and appears to improve knowledge and skills. Bybee (2009) also affirms the model as beneficial for students since it involves them to learn with a purpose rather than memorize facts. The study of Bybee and colleagues (2006) verifies this statement as significant difference yield between 5E model and traditional method. It is stressed that the 5E model was effective in classroom situations due to a more student engagement at the same time let them gain hands-on experiences. Recent researches such as those of Schallert et al. (2020), Tezer and Cumhur (2017) express the same point that 5E inquiry model is a better method for effective learning.

Table 10. Significant difference of posttest achievement in algebraic expressions between control and experimental group

Test Compared	Test Used	Mean Score		t-test for comparison of means			
		Control	*Experimental*	Mean Difference	t	df	*p*-value
Posttest	Independent Two-Sample t-test	10.63	15.13	4.500	5.945**	46	<0.001

Note: Levene's Test Results: F-value= 0.215, sig. value=0.645; thus, equal variances assumed.
** - highly significant at 1% level.

4. CONCLUSION

The focus of this study is to determine the effect of 5E Guided Inquiry Model on mathematics achievement of grade 7 learners. Conclusively, teaching algebraic expressions using 5E Guided Inquiry Model gives a positive impact on students' achievement since it brings them completely to the constructive learning process described by constructivist principles which gives them meaningful engagement to authentic experiences through learning-by-doing tasks thereby enable them to improve significantly their achievement in algebraic expressions. Being able to let learners understand how and why they need to know about algebraic concepts reflects the positive effect of 5E guided inquiry model towards teaching-learning process

5. RECOMMENDATIONS

Teachers should be encouraged to use 5E Guided Inquiry Model in teaching mathematics as it helps improve the achievement of the students. The Department of Education is encouraged to provide teachers with adequate seminar, training-workshop that enhance their competencies in areas of instruction especially when using new and effective strategies and approaches such as 5E Guided inquiry model. Traditional method should not be discouraged totally. This must be integrated more or less with other methods in order to facilitate learning more effectively. Technical support must also be given to teachers in order guide them properly in facilitating inquiry lessons. Encourage other researchers to conduct parallel studies using another grade level of respondents as subject and another mathematical content to involve. Lateral studies may also be made relating inquiry model with other dimensions such variables as motivation to learn, critical thinking, problem-solving abilities and perception in mathematics.

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