VIRTUAL INSTRUCTIONAL MATERIALS IN TEACHING ALGEBRA

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Abstract

This study aimed to determine the effectiveness of virtual instructional materials of selected Grade 7 students of Nanhaya National High School.

Based on the data analyzed, the level of virtual instructional materials in terms of usability, appropriateness, flexibility and self-efficacy were "Very High". The level of student's performance in Algebra in regards to pre-test of the Grade 7 students was "Fair" while the level of student's performance in Algebra in regards to post-test of the Grade 7 students was "Satisfactory". The computed t-value of 17.475 is beyond the critical value of ±1.987 with a p-value of 0.000 at 0.05 level of significance and 89 degree of freedom. Based from the given data, it can be concluded that the virtual instructional materials have a significant difference on the performance in Algebra of the students. The computed f-value of 1.188 is less than the critical value of ±3.316 with a p-value of 0.322 at 0.05 level of significance and 89 degree of freedom. It implies that using virtual instructional material in Algebra is not effective. Based from the given data, it can be concluded that the virtual instructional materials have no significant effect on the performance in Algebra of the students.

Based on the findings and conclusions, the following recommendation
were drawn: the use of Math Apps may help the students to support their independent learning so that there will no gap during learning process. The researcher suggests that teacher may use other different techniques or instructional materials that can motivate them and improve their performance.Other researchers can use this study to help them further analyze and improve the use of virtual instructional materials to students using different variables and different research design.
Keywords: Virtual Instructional Materials; Performance; Algebra; Math Application

1. Main text

Introduction

Nowadays, we need to evolve and enhance the teaching-learning process and instruction in the field of education. Math instructional materials are objects that are designed to represent explicitly and concretely mathematical ideas that are abstract (Moyer, 2005). Math manipulatives have been around for years. The use of instructional materials in teaching mathematics has a long tradition and solid research history. Manipulatives not only allow students to construct their own cognitive models for abstract mathematical ideas and processes, they also provide a common language with which to communicate these models to the teacher and other students. In addition to the ability of manipulatives to aid directly in the cognitive process, instructional materials have the additional advantage of engaging students and increasing both interest in and enjoyment of mathematics. Students who are presented with the opportunity to use manipulatives report that they are more interested in mathematics. Long-term interest in Mathematics translates to increased mathematical ability.

With the development of ICT system, the traditional set up of teaching-learning process are in the process of developing new virtual spaces that are designed for learning. Teachers are students are adapting to

this new method of communication and learning through differently organized learning environment. The emergence of virtual learning environments gives wider opportunities for all learners or individuals who combine work and study. Considering education as a socio-technical system is a new paradigm and, therefore, both teachers and learners should consider the use of virtual instructional materials. The task of teachers and learners is to acquire skills that would allow them to accommodate quickly to the emerged changes. Indeed, by using virtual instructional material, both can progress in the process and providing quality results.

Virtual instructional materials can be used as a tool in a Math class in increasing the retention of students. These are designed to help students understand abstract math concepts, provide more complex understanding of concepts, and clarify student misconceptions and build connections between concepts and representatives (Center on Technology and Implementation, 2011). This only can be said that these can help a lot for learners in our generation. It can be an aid directly in the cognitive process, manipulatives have the additional advantage of engaging students and increasing both interest in and enjoyment of mathematics.
Indeed, students' mathematical proficiency, leaders and teachers systematically integrate the use of virtual manipulatives into classroom instruction at all grade level (NCSM, 2014).

The researcher chose to do the study for the reason to distinguish the advantage and disadvantage of virtual instructional materials in Algebra. This will help the learners enhance their mathematical skills using virtual instructional materials. With such interest, they must successfully use it to determine their level of mathematical problem-solving skills. Most of the students in high school are having difficulties in solving mathematical problems. This trend also exists, specifically, in Nanhaya National High School, Victoria, Laguna where this study will be conducted.

The researcher experienced this kind of problem and decided to conduct a study on effectiveness of virtual instructional materials, specifically, Grade 7 students of Nanhaya National High School. This will not only help the respondents but also other students who have difficulties in solving mathematical problems.

Theoretical Framework

Theories help the researchers in understanding the things which are unusual and cannot be explained explicitly. Through these, researchers were able to learn things.

Researchers emphasized the importance of authentic learning experiences and the use of concrete tools as an important stage in development of understanding. Piaget suggest that children begin to understand symbols and abstract concepts only after experiencing the ideas on a concrete level. While Dienes extended this to suggest that children begin to suggest that students whose mathematical learning is firmly grounded in manipulative experiences will be more likely to bridge the gap between the world in which they live and the abstract world of Mathematics in ETA hand2mind (2017).

According to Huitt and Hummel (2003), Piaget's theory of cognitive development undergoes stages that becomes increasingly more complex as one passed each stage namely sensorimotor, pre-operational, concrete and formal operational stage. As one structure become more complex, they are organized in a hierarchical manner. According to him, learners move through four stages of intellectual development (sensorimotor, preoperational, concrete operations, and formal operations) and learning involves either add new information to existing psychological frameworks (assimilation) or developing or evolving new cognitive structures (accommodation). He hypothesized that children were not mentally mature enough to grasp abstract mathematical concepts if their teachers only presented the concepts in writing (using words, numbers and symbols). Also, students need several experiences with instructional materials and drawing in order to learn abstract concepts. Piaget believed that as learners matures, their need for concrete experiences diminishes but never ceases.

The theory of experiential education revolves around the idea that learning is enhanced when students acquire knowledge through active processes that engage them (Heddens, 1986; Reisman, 1982). They say that manipulatives can be key in providing effective, active, engaging lessons in the teaching of Mathematics.

Instructional materials help students learn by allowing them to move from concrete experiences to abstract reasoning. Experts in the field of education post that learning takes place in three stages. The use of manipulatives helps learners hone their mathematical thinking skills.

According to Stein and Bovalino (2001), "Manipulatives can be important tools in helping students to think and reason in more meaningful ways. By giving students concrete ways to compare and operate on quantities, such manipulatives as pattern blocks, tiles, and cubes can contribute to the development of well-grounded, interconnected understanding of mathematical ideas.". To gain a deep understanding of mathematical ideas, students need to be able to integrate and connect a variety of concepts in many different ways. They call this type of understanding "Integrated-Concrete" knowledge. The effective use of manipulatives can help learners connect ideas and integrate their knowledge so that they can gain a wide understanding of mathematical concepts. Teachers play a significant role in the teaching-learning process in helping students use manipulatives successfully, so that they move to the three stages of learning and arrive at a deep understanding of mathematical concepts.

Based from the theories above, through the use of instructional materials in teaching, students are likely to integrate their knowledge since they are able to experience and create meaningful ideas through the use of it. Through the use of virtual instructional materials, learners are able to learn from simple before going to complex and is more likely to increase retention in learning. The aforementioned theories are able to create strong evidence that using virtual instructional materials can increase the performance of students in Algebra.

Statement of the Problem

The primary purpose of this study is to determine the effectiveness of virtual instructional materials of selected Grade 7 students of Nanhaya National High School.

Specifically, it aims to answer the following questions:

1. What is the level of virtual instructional materials in terms of:
- usability;
- appropriateness;
- flexibility; and
- self-efficacy?
2. What is the level of students' performance in Algebra in regards to:
- pre-test; and
- post-test?
3. Is there any significant difference in students' pre-test and posttest?
4. Do the virtual instructional materials have significant effect to the teaching in Algebra of selected Grade 7 students of Nanhaya National High School?

Research Methodology

A quantitative research design was chosen to examine the Effectiveness of Virtual Instructional Materials of Grade 7 students. A quantitative pre-test and post-test design which is also known as the one-group experimental research design, will be used to test whether the virtual instructional material will be effective for a student's math achievement and performance.

The respondents of the study were composed of two (2) grade seven sections which has a total of ninety (90) students of Nanhaya National Highschool Victoria, Laguna. That said, the two sections received the same virtual instructional materials. They are the ones who have enough knowledge to answer the problems posed in our study. All the data of the students who will agree to be a part of the study will be included in the data collection and analysis. Students are able to use their cellphones, tablets or laptops in accessing the virtual instructional materials. The performance of all respondents represents all Grade 7 students, which undergo a certain application of using e-based virtual instructional materials.

The researcher made a questionnaire-checklist, pre-test and post-test. With the aid of the prepared instruments that will be distributed to the purposively chosen respondents, data will be collected. The researcher will ask permission from the principal and advisers of the selected Grade 7 students of Nanhaya National High School by means of request letter to gather the data needed with the letter of endorsement from the Division office of Laguna and the approval of the district office signed by the district supervisor. The respondents were composed of two sections with a total of 90 students.

First, the researcher gave the pre-test to the respondents. After the pre-test will be collected, the researcher discussed a lesson regarding algebra which we will use virtual instructional materials. And then, post-test will be given to the respondents. Lastly, the researcher gave questionnaires to test their perception. The researcher collected the papers after they were answered. The test and questionnaire results guided the researcher in determining the effectiveness virtual instructional materials of Grade 7 students.

The data based on the information that was taken from the respondents were tabulated, analyzed and interpreted by the researcher. The mean was used to measure the mean scores in algebraic thinking before and after using virtual instructional materials of the Grade 7 students. Standard deviation was used along with t-test to determine if there was a significant effect on the pre-test and post-test results of the students. T-test (Paired Two Sample for Means) was used to determine the significant difference between the mean level of the pre-test and post-test scores. Analysis of Variance (ANOVA) was used to determine the significant effect between the performance of the students in Algebra using virtual instructional materials.

Results and Discussion

1. Level of Virtual Instructional Materials

The following tables shows the level of virtual instructional materials in terms of usability, appropriateness, flexibility and self-efficacy.

Table 1. Level of Virtual Instructional Materials in terms of Usability

Virtual instructional materials…	**Mean**	**SD**	**Remarks**
…are easy to use.	4.60	0.60	Strongly Agree
…serve as a motivation in solving mathematical problems.	4.73	0.51	Strongly Agree
…make me comfortable and would like to use these frequently.	4.49	0.57	Strongly Agree
…I gain a better understanding in the concepts presented.	4.72	0.45	Strongly Agree
…help me to achieve the task easily.	4.62	0.51	Strongly Agree

Overall Mean = 4.63
Standard Deviation = 0.34
Verbal Interpretation = Very High

Table 1 presents the level of virtual instructional materials in terms of usability.

The table shows that the first statement, which was “Virtual instructional materials are easy to use.” has (M = 4.60, SD = 0.60), and remarked as Strongly Agree for its level. The second statement, which was “Serve as a motivation in solving mathematical problems.” has (M = 4.73, SD = 0.51), and remarked as Strongly Agree for its level. The third statement which was “Make me comfortable and would like to use these frequently.” has (M = 4.49, SD = 0.57), and remarked as Strongly Agree for its level. The fourth statement which was “I gain a better understanding in the concepts presented.” has (M = 4.72, SD = 0.45), and remarked

as Strongly Agree for its level. "Help me to achieve the task easily" has (M = 4.62, SD = 0.51), and remarked as Strongly Agree for its level.

The overall mean value of 4.63 and a standard deviation of 0.34 revealed that the level of virtual instructional materials in terms of usability was "Very High". This implies that the usability of virtual instructional materials has very high effectiveness to the performance of the students.

Table 2. Level of Virtual Instructional Materials in terms of Appropriateness

Virtual instructional materials…	**Mean**	**SD**	**Remarks**
…assist to compute in a shorter time.	4.64	0.53	Strongly Agree
…are valuable and fit in solving mathematical problems.	4.62	0.55	Strongly Agree
…sharpen my mind and help to develop my critical thinking skills	4.67	0.54	Strongly Agree
…widen my quality of learning the lesson.	4.61	0.49	Strongly Agree
…provide adequate assistance to solve using it and complete the task.	4.66	0.52	Strongly Agree

Overall Mean = 4.64
Standard Deviation = 0.37
Verbal Interpretation = Very High

The table shows that the first statement, which was "Virtual instructional materials assist to compute in a shorter time." has (M = 4.64, SD = 0.53), and remarked as Strongly Agree for its level. The second statement, which was "Are valuable and fit in solving mathematical problems." has (M = 4.62, SD = 0.55), and remarked as Strongly Agree for its level. The third statement which was "Sharpen my mind and help to develop my critical thinking skills" has (M = 4.7, SD = 0.54), and remarked as Strongly Agree for its level. The fourth statement which was "Widen my quality of learning the lesson." (M = 4.61, SD = 0.49), and remarked as Strongly Agree for its level. "Provide adequate assistance to solve using it and complete the task." has (M = 4.62, SD = 0.52), and remarked as Strongly Agree for its level.

The overall mean value of 4.64 and a standard deviation of 0.37 revealed that the level of virtual instructional materials in terms of appropriateness was "Very High". This implies virtual instructional materials directly affects the learning of students since it was appropriate for the lesson.

Table 3. Level of Virtual Instructional Materials in terms of Flexibility

Virtual instructional materials…	**Mean**	**SD**	**Remarks**
…aid to solve the mathematical problem to finish the mathematical on time.	4.76	0.46	Strongly Agree
…are able to help in providing strategies to solve the problem.	4.76	0.48	Strongly Agree
…can be easily manipulated and used to solve the task.	4.69	0.49	Strongly Agree
…provide assistance in solving difficult mathematical problems	4.69	0.49	Strongly Agree
…help me to show tactfulness in doing the task.	4.72	0.47	Strongly Agree

Weighted Mean = 4.72
Standard Deviation = 0.31
Verbal Interpretation = Very High

Based on the table, the first statement, which was "Virtual instructional materials aid to solve the mathematical problem to finish the mathematical on time." has (M = 4.76, SD = 0.46), and remarked as Strongly Agree for its level. The second statement, which was "Are able to help in providing strategies to solve the problem." has (M = 4.76, SD = 0.48), and remarked as Strongly Agree for its level. The third statement which was "Can be easily manipulated and used to solve the task." has (M = 4.69, SD = 0.49), and remarked as Strongly Agree for its level. The fourth statement which was "Provide assistance in solving difficult mathematical problems." has (M = 4.69, SD = 0.49), and remarked as Strongly Agree for its level. "Help me to show tactfulness in doing the task." has (M = 4.72, SD = 0.47), and remarked as Strongly Agree for its level.

The overall mean value of 4.72 and a standard deviation of 0.32 revealed that the level of virtual instructional materials in terms of flexibility was "Very High". It implies that when students are able to manipulate the virtual instructional materials, they are able to show very high flexibility.

Table 4. Level of Virtual Instructional Materials in terms of Self-Efficacy

Virtual instructional materials…	**Mean**	**SD**	**Remarks**
…are interesting and engaging.	4.81	0.39	Strongly Agree
…boost my self-confidence in solving the mathematical problems.	4.83	0.37	Strongly Agree
…help me to acquire learning.	4.72	0.47	Strongly Agree
…are enjoyably to use and can assist in having positive results	4.80	0.43	Strongly Agree
…help me to improve myself and do task with enthusiasm.	4.88	0.33	Strongly Agree

Weighted Mean = 4.81
Standard Deviation = 0.27
Verbal Interpretation = Very High

Based on the table, the first statement, which was "Virtual instructional materials are interesting and engaging." has (M = 4.81, SD = 0.39), and remarked as Strongly Agree for its level. The second statement, which was "Boost my self-confidence in solving the mathematical problems." Has (M = 4.83, SD = 0.37), and remarked as Strongly Agree for its level. The third statement which was "Help me to acquire learning." has (M = 4.72, SD = 0.47), and remarked as Strongly Agree for its level. The fourth statement which was "Are enjoyably to use and can assist in having positive results" has (M = 4.80, SD = 0.43), and remarked as Strongly Agree for its level. "Help me to improve myself and do task with enthusiasm." has (M = 4.88, SD = 0.33), and remarked as Strongly Agree for its level.

The overall mean value of 4.81 and a standard deviation of 0.27 revealed that the level of virtual instructional materials in terms of self-efficacy was "Very High". This implies that student's self-efficacy has a very high effectiveness to students using virtual instructional materials.

2. Level of Student's Performance in Algebra

The following tables discusses the performance of students before and after they use the virtual instructional materials using pre-test and post-test.

Table 5. Level of Student's Performance in Algebra In Regards to Pre-test

Score	**Frequency**	**Relative Frequency (in %)**	**Remarks**

26-30	0	0%	Outstanding
21-25	1	1.11%	Very Satisfactory
16-20	18	20%	Satisfactory
11-15	32	35.56%	Fair
10 and below	39	43.33%	Poor
Total	90	100 %	

Overall Mean = 11.08
Standard Deviation = 3.88
Verbal Interpretation = Fair

Table 5 presents the level of student's performance in Algebra in regards to pre-test.

Table 5 shows that there are no students scored 26-30 which is 0 or 0% under the level of Outstanding, 1 or 1.11% of them scored from 21 to 25 under the level of Very Satisfactory, 18 or 20% of them scored from 16 to 20 under the level of Satisfactory, 32 or 35.56% of them scored from 11 to 15 under the level of Fair, and, 39 or 43.33% of them scored from 0 to 10 under the level of Poor.

The overall mean of 11.08 with standard deviation of 3.88 reveals that the level of student's performance in Algebra in regards to pre-test of the Grade 7 students was "Fair". This implies that student's performance and existing knowledge about the lesson is average since they are not yet introduced to the virtual instructional materials.

Table 6. Level of Student's Performance in Algebra In Regards to Post-test

Score	Frequency	Relative Frequency (in %)	Remarks
26-30	1	1.11%	Outstanding
21-25	12	13.33%	Very Satisfactory
16-20	35	38.89%	Satisfactory
11-15	34	37.78%	Fair
10 and below	8	8.89%	Poor
Total	90	100 %	

Overall Mean = 16. 17
Standard Deviation = 4.23
Verbal Interpretation = Satisfactory

Table 6 shows that there are is 1 student scored 26-30 which is 1 or 1.11% under the level of Outstanding, 12 or 13.33% of them scored from 21 to 25 under the level of Very Satisfactory, 35 or 38.89% of them scored from 16 to 20 under the level of Satisfactory, 34 or 37.78% of them scored from 11 to 15 under the level of Fair, and, 8 or 8.89% of them scored from 0 to 10 under the level of Poor.

The overall mean of 16.17 with standard deviation of 4.23 reveals that the level of student's performance in Algebra in regards to post-test of the Grade 7 students was "Satisfactory". It implies that after the students are able to use the virtual instructional materials, their performance improved and better results are seen throughout the process.

3. Significant Difference between Students' Pre-test and Post-test

Table 7. Significant Difference between Students' Pre-test and Post-test

Criteria	Mean	Df	Computed t-value	Critical Value	p-value	Analysis
Pre-test	11.08	89	17.475	1.987	0.000	**Significant**

Post-test	16.17					

α = 0.05

Table 7 presents the significant difference between students' pre-test and post-test.

The table shows that pre-test and post-test mean value of 11.08 and 16.17. It further reveals that the computed t-value of 17.475 is beyond the critical value of ±1.987 with a p-value of 0.000 at 0.05 level of significance and 89 degree of freedom. Therefore, the hypothesis stating that the pre-test and post-test results has no significant difference in the performance in Algebra of students was rejected. It implies that the virtual instructional material is effective and able to have an improvement on the performance of the students. Based from the given data, it can be concluded that the virtual instructional materials have a significant difference on the performance in Algebra of the students.

4. Significant Effect of Virtual Instructional Materials to the Teaching in Algebra

This table shows if there is a significant effect of virtual instructional materials to the teaching in algebra.

Table 8. Significant Effect of Virtual Instructional Materials to the Teaching in Algebra

Criteria	Computed f-value	Critical Value	p-value	Analysis
Virtual Instructional Materials	1.188	3.316	0.322	**Not Significant**
Post-test				

α = 0.05

Table 8 presents the significant effect of virtual instructional materials to the teaching in algebra

The table reveals that the computed f-value of 1.188 is less than the critical value of ±3.316 with a p-value of 0.322 at 0.05 level of significance and 89 degree of freedom. Therefore, the hypothesis stating that there is no significant effect of virtual instructional materials to the teaching in algebra is accepted. It implies that there are some factors that might affect the study to make the results not significant and making an effect to the performance of the students and determine its acceptability using the virtual instructional materials. Based from the given data, it can be concluded that the virtual instructional materials have no significant effect on the performance in Algebra of the students.

Summary of Findings

This study aimed to determine the effectiveness of virtual instructional materials of selected Grade 7 students of Nanhaya National High School. It aims to answer the following questions: (1) What is the level of virtual instructional materials in terms of usability, appropriateness, flexibility, and self-efficacy? (2) What is the level of students' performance in Algebra in with regards to pre-test and post-test? (3) Is there any significant difference in students' pre-test and posttest? (4) Do the virtual instructional materials have significant effect to the teaching in Algebra of selected Grade 7 students of Nanhaya National High School?

Based on the data analyzed, the level of virtual instructional materials in terms of usability, appropriateness, flexibility and self-efficacy were "Very High".

The level of student's performance in Algebra in regards to pre-test of the Grade 7 students was "Fair"

while the level of student's performance in Algebra in regards to post-test of the Grade 7 students was "Satisfactory".

The computed t-value of 17.475 is beyond the critical value of ±1.987 with a p-value of 0.000 at 0.05 level of significance and 89 degree of freedom. Based from the given data, it can be concluded that the virtual instructional materials have a significant difference on the performance in Algebra of the students.

The computed f-value of 1.188 is less than the critical value of ±3.316 with a p-value of 0.322 at 0.05 level of significance and 89 degree of freedom. It implies that using virtual instructional material in Algebra is not effective. Based from the given data, it can be concluded that the virtual instructional materials have no significant effect on the performance in Algebra of the students.

Conclusion

Based on the different findings of the study, the following conclusions are hereby concluded based on the statement of the problem:

The respondents' Level of Virtual Instructional Materials in terms of Usability, Appropriateness, Flexibility and Self-Efficacy were Very Beneficial. The performance of Grade 7 students in Algebra in the pre-test and post-test using virtual instructional materials were Fair and Satisfactory respectively. It it can be concluded that the virtual instructional materials have a significant difference on the performance in Algebra of the students.

Therefore, the hypothesis stating that the pre-test and post-test has no significant difference in the performance in Algebra of students was rejected. It implies that using virtual instructional materials is effective and positively affect the performance in solving mathematical problems.

Therefore, the hypothesis stating that there is no significant effect of virtual instructional materials to the teaching in algebra is accepted. It implies that using virtual instructional material in Algebra is not effective. Based from the given data, it can be concluded that the virtual instructional materials have no significant effect on the performance in Algebra of the students.

Recommendations

Based on the conclusions drawn from the study, the following were recommended:

1. Through the finding of this study, students may spend their time to gather different virtual instructional materials that may best help them in learning mathematics especially in this new normal education where you are to learn independently. The use of Math Apps may help the students to support their independent learning so that there will no gap during learning process.
2. Since the study found out that there is improvement on the algebra performance of the students, the teacher may also use and find different math apps that can be paired in their selected topics. The teacher may also use different representations and guide students to use different representations as they explore mathematical ideas, develop and share solutions to problems or ask questions.
3. Since it was found out that the virtual instructional materials have no significant effect on the performance in Algebra of the students, the researcher suggests that teacher may use other different techniques or instructional materials that can motivate them and improve their performance and also to help the students to easily solve a certain Mathematical problem. The researcher also recommends that the teacher must have a wide range of knowledge about the instructional materials to be used. And the teacher must find other ways of teaching methods such as adapting new and appropriate techniques and strategies.
4. Other researchers can use this study to help them further analyze and improve the use of virtual instructional materials to students using different variables and different research design.

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