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Development and Validation of Computer-Aided Game in Teaching Operations in Polynomials for Grade 7 Students

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Abstract: ***This study aims to develop and validate the Computer-Aided Game (CAG) in Teaching Operations in Polynomials for Grade 7 in Bulan National High School S.Y. 2019-2020. This study utilizes the program PowerPoint to develop a computer-aided game in teaching operations in polynomials. Questionnaires are given to the respondents in conducting the study and collected all the gathered results afterwards. The literatures of the study focus on the computer-aided instruction and computer-based games in teaching. The study was conducted on the sample of 60 grade 7 students of Bulan National High School divided into two equal groups, 30 to the control group and 30 to the experimental group. The findings of the study revealed that in terms of pre-tests between control and experimental group, there is no significant difference. In contrast, the post tests between control and experimental group have shown significant difference. In addition, there is a significant difference between the pre-test and post test of the experimental group. In terms of engagement of students in the computer-aided game, the students are engaged with the game. In addition, the ICT experts and teachers have accepted the computer-aided game in terms of content, usefulness, suitability, adequacy and timeliness.***

Keywords: Computer Aided, Game

1. Introduction

Japan's educational system, in particular its K-12 schools, remains one of the very best in the world. Japan's greatest educational achievement is the high-quality basic education youngest people receive by the time they complete high school. In international mathematics tests, Japanese students rank either at or near the top year after year. Recent statistics indicate that well over 95 percent of Japanese are literate, which is particularly impressive since the Japanese language is one of the world's most difficult languages to read and write. Over 95 percent of Japanese also graduate from high school compared to 88 percent of American students. Some Japanese education specialists estimate that the average Japanese high school graduate has attained about the same level of education as the average American after two years of college. Japanese employees of large companies and government ministries rank among the well-educated workers on earth (eric.ed.gov).

Mainly, the role of the secondary school teachers is evolving from that of a spoon feeding of information to that of a facilitator of student learning. New technologies already exist to help teachers complete that evolution (Downs, Clark and Bennet, 1995).

The K-12 educational system of the Philippines plays a crucial part to the prosperity of the nation. The declaration of the 1987 Constitution Section 1 of Article XIV states that: The state shall protect and promote the right of all citizens to quality education at all levels and shall take appropriate steps to make such education accessible to all.

Various researches and studies have been conducted aiming to create an effective delivery of instruction to the students inside the classroom. High quality instructions will lead to excellence. This is the part where the government has been seeking an answer for over the years.

With the dawn of technology, various technologies were introduced in the Philippine educational system. With the dominance of computers, computer literacy has always been a part of modern day classroom instructions. The utilization of computers in the learning process makes it more interesting, enjoyable, convenient and effective both on the teachers and the learners (Peralta, 2011).

Teachers must be the first one to be educated on how to utilize the capabilities of the technologies. They should develop basic skills in computer such as word processing, spreadsheets, presentations and Web browsing. These skills will guide them a lot not only in the classroom instructions but also to some other tasks related to their functions as educators.

Oladobe, Herselman, and Jacobs (2006) stated that most developed countries have exploited the potentials of ICT to transform their educational process. With the advent of ICT, it is expected that there should be revolutionalization in the pedagogical methods of teaching which would lead to quality education and improved educational systems.

The fast developments in information and communication technologies are proposing new potentials for producing and hand out knowledge. These practices have basically changed how people live and work as well as how they learn and have renovated the world into global community. The technological innovations in telecommunications with the ability to store, transmit, access and utilize information, the vital instrument used in the modern era is the computer. Connectivity has allowed new forms of communication to evolve. The primary and secondary education as well as the tertiary education should not be left out in this global connectivity.

In this 21st century, millions of people are interested in having a skill in computer. This is because most work fields require the knowledge in computer.

Furthermore, section 10 of Article XIV of the 1987 Constitution of the Republic of the Philippines mandates that the State shall give priority to research and development, invention, innovation and their utilization; and to science and technology education, training, and services. It shall support indigenous, appropriate, and self-reliant scientific and technological capabilities, and their application to the country's productive systems and national life.

DepEd Computerization Program aims to provide Public Schools with appropriate technologies that would enhance the teaching-learning process and meet the challenges of the 21st century. This program shall respond to the computer backlog of public schools by providing them hardware and software, and training on simple trouble shooting, (DepEd Order No. 78, s. 2010).

Public secondary schools in Bulan received several units of computer because of the Computerization Program of the Department of Education. Nevertheless, these computers were not properly used for majority of the teachers have insufficient knowledge on how to use these. Some of the teachers claimed that they don't have enough computers to use.

As observed by the researcher, most of the teachers were sent to trainings and seminars, and still they don't have enough knowledge and skills to operate computers especially in Web Browsing and PowerPoint presentation. And also, the K-12 Curriculum here in the Philippines mainly focuses on student-centered learning. By these situations, the researcher was decided ad encouraged to conduct the study.

Statement of the Problem

The study aims to develop and validate the Computer-Aided Game (CAG) in Teaching Operations in Polynomials for Grade 7 in Bulan National High School S.Y. 2019-2020. This study aims to answer the following questions:

1) What Computer-Aided Game (CAG) that can be developed in teaching Operations in Polynomials?
2) What is the mastery level of control and experimental group in the pre-test?
3) Is there a significant difference between control and experimental group in the pre-test?
4) What is the mastery level of control and experimental group in the post test?
5) Is there a significant difference between control and experimental group in the post test?
6) Is there a significant difference between the pre test and post test of experimental group?
7) How engaged are the students on the use of CAG in Operations of Polynomials?
8) What is the acceptability of CAG as perceived by experts?

2. Methodology

This study was about developing and validating of computer-aided game in teaching operations in polynomials. The t-test for independent samples and t-test for dependent samples were used in this study. The respondents of this study were the Grade 7 students and teachers in Bulan National High School.

This study used descriptive-developmental method and quasi-experimental method. The Computer-Aided Game (CAG) is an integration of game to the computer-aided instruction (CAI). The researcher based the computer-aided game from a Pambata magazine, integrating the places around Sorsogon and the questions used for this game is all about operations in polynomials, and made from PowerPoint to form a CAG. The CAG will be presented to the teachers and will be used to utilize it after the lessons in operations in polynomialsand played by the students. After the presentation of CAG to the teachers, the researcher will use quasi-experimental method to divide the Grade 7 students into two groups, the control group and experimental group. The control group and the experimental group will be given the same lesson and will be given pre-test and post test but the experimental group will be given the CAG before the post test.

The Sample

Grade 7 students who are currently attending school at Bulan National High School were the respondents of these study. Using random sampling, 60 Grade 7 students that will be divided into two groups, 30 to the control group and 30 to the experimental group.

The Instrument

The main instrument that was used in gathering the needed data was a questionnaire in which it was divided into two parts: Part I is for ICT Experts and teachers in which it consists of questionnaire-checklist and Part II is for students in which it consists of three sub-parts: (1) pre-test; (2) post-test and (3) questionnaire-checklist in which it includes the guide questions after teaching the two methods. The main instrument that was used was subject for a dry-run conducted on February 3-7, 2020 at Cadandanan National High School, Cadandanan, Bulan, Sorsogon to determine its validity and to ensure the reliability of the test. The test was administered on February 17-21, 2020 at Bulan National High School, Bulan, Sorsogon since the topic is covered during the fourth quarter period.

Data Collection Procedures

Before the conduct of the study, the researcher asked permission from the Superintendent and the School Head of Bulan National High School. Upon approval, the researcher administered the distribution of the Part I of the questionnaire to the Math teachers and ICT Experts. There are four experts who will validate the computer-aided game. All four experts are from Bulan National High School. Expert 1 is a head teacher of Mathematics Department, Expert 2 and Expert 3 are master teachers of Mathematics Department and Expert 4 is an ICT Coordinator. The researcher will divide the group into two groups, the control group and the experimental group. The researcher will conduct a pre-test to the two groups before the start of the lesson. In the control group, the researcher will use traditional method of teaching with its contents mostly are abstract concepts of the topic to be discussed. In the experimental group, the researcher will give the computer-aided game in addition of the use of computer-aided

instruction. After the discussion, the researcher will give a post-test to the two groups. Then, the researcher will give the experimental group the questionnaire-checklist about the students' engagement with CAG. The responses were tallied to check the effectivity of the instrument and rechecked for statistical interpretation.

3. Data Analysis Procedures

The collected data were tabulated, analyzed and interpreted with the use of appropriate statistical measures and techniques. Frequency count, percentage, weighted mean, t-test for independent samples and t-test for dependent samples were used to determine the validation of computer-aided game.

In determining the significant difference of performance in pre-test and post test of control group; and pre-test and post test of experimental group in operations in polynomials, inferential statistics was used. The inferential statistics used in this study was t-test for dependent samples.

To determine the significant difference of performance of students in Operations in Polynomialsin terms of post-test of control and experimental group, inferential statistics was used. Specifically, the inferential statistics used in this study was t-test for independent samples.

The level of mastery level of students on operations in polynomials was also determined through percentage of the students who got the correct answer in each item. The result was interpreted using the following scale from National Education Testing and Research Center (NETRC).

Mastery Level	Descriptive Equivalent
0% - 4%	Absolutely No Mastery
5% - 14%	Very Low Mastery
15% - 34%	Low Mastery
35% - 65%	Average Mastery
66% - 84%	Moving Towards Mastery
85% - 95%	Closely Approaching Mastery
96% - 100%	Mastered

4. Results and Discussions

Findings

Based from the data gathered, the following findings were revealed:

1) The researcher developed an output which is a computer-aided game in a form of PowerPoint presentation. The computer-aided game which is called the Questionomials which is played after the lesson proper which is the Operations on Polynomials.
2) It is shown that the students in control group who answered item number 1 has the highest rating with 57% and item number 30 has the lowest rating with 3%. The average mastery level rating of control group is 19%. It is shown that the students of experimental group who answered item number 1 got a rating of 70% which is the highest and items 6 and 23 got a rating of 3% which is the lowest. The average rating of experimental group in the pre-test is 18%.
3) The computed t-value is 0.26 which is less than the critical value of 2.002 with a 0.05 level of significance and degree of freedom of 58. Hence, the hypothesis that is stated in null form is to be accepted.
4) It is shown in the table that the students of the experimental group's 90% got item number 2 which is the highest and 23% of got items 7 and 28 which is the lowest. The average mastery rating is 42%. It is shown in the table that the students of experimental group's 90% got item number 2 which is the highest and 27% got item number 19 which is the lowest. The average mastery rating is 52%.
5) The computed t-value is 2.32 which is less than the critical value of 2.002 with a 0.05 level of significance and degree of freedom of 58. Hence, the hypothesis that is stated in null form is to be rejected.
6) The computed t-value is 12.94 which is less than the critical value of 2.045 with a 0.05 level of significance and degree of freedom of 29. Hence, the hypothesis that is stated in null form is to be rejected.
7) The result shows that students answered under the statements "Learning the game controls was easy" and "The game controls were intuitive" have a weighted mean of 4.3 which is the highest and the statement "When I wanted to do something in the game, it was easy to remember the game controls" have a weighted mean of 4 which is the lowest. The average weighted mean of engagement of students in playing Questionomials was 4.16.
8) The experts perceived that they very much accepted that the program's information suits the students' level of comprehension teachers. The experts have accepted very much the CAG in terms of its clarity of content. The experts have very much accepted the CAG in terms of the statements "The program is simple" and "The program has contents that increase the students' knowledge, understanding and proficiency/skills". Experts have accepted the Computer-aided Game (CAG) in terms of its usefulness. The experts have much accepted the program's activities. In addition, the experts accepted the CAG in terms of its suitability. The experts accepted that the program provides expected learning. In addition, experts have accepted the CAG in terms of its adequacy. The experts very much accepted the most under the statement "Teachers are encouraged to produce learning module to make teaching-learning effective". In addition, experts have very much accepted the CAG in terms of its timeliness.

Conclusions

Based on the findings of the study, the researcher arrived at the following conclusions:

1) The researcher made a computer-aided game which is developed and validated, in a form of PowerPoint presentation. The computer-aided game which is called the Questionomials which is played after the lesson proper which is the Operations on Polynomials.
2) Item number 1 was the easiest to the students in the control group and item number 30 was the most difficult. Most of the students in the control group have low knowledge in Operations in Polynomials. Item number 1 was the easiest to answer by the students in the

experimental group and items 6 and 23 was the most difficult. Most of the students in the experimental group have low knowledge in Operations in Polynomials.

3) There is no significant difference between the control group and experimental group in their pre-test in the topic Operations in Polynomials. The decision indicated that the pre-test of control group and experimental group is not significantly different to each other.
4) Item number 2 was the easiest for the students in the control group and items 7 and 28 were the most difficult. Most of the students in the control group have average knowledge in Operations in Polynomials. The students experimental group find it easiest to answer item number 2 and most difficult to answer item number 19. Most of the students have average knowledge in Operations in Polynomials.
5) There is a significant difference between the control group and experimental group in their post test in the topic Operations in Polynomials. The decision indicated that the pre-test of control group and experimental group is significantly different to each other.
6) There is a significant difference between the pre-test and post test of experimental group in the topic Operations in Polynomials.The decision indicated that the pre-test and post test of experimental group is significantly different to each other.
7) Most of the students have it easy in terms of game controls and that the game controls are intuitive to them. Moreover, most students liked playing Questionomials.
8) The experts have interpreted that they very much accepted the CAG in terms of its clarity of content. Therefore, the experts have highly acknowledged the CAG when it comes to its clarity of content. The experts have interpreted that they accepted the CAG in terms of its usefulness. Therefore, the experts have acknowledged the CAG when it comes to its usefulness. The experts have interpreted that they accepted the CAG in terms of its suitability. Therefore, the experts have acknowledged the CAG when it comes to its suitability. The experts have interpreted that they accepted the CAG in terms of its adequacy. Therefore, the experts have acknowledged the CAG when it comes to its adequacy. The experts have interpreted that they very much accepted the CAG in terms of its timeliness. Therefore, the experts have highly acknowledged the CAG when it comes to its usefulness.

5. Recommendations

Based from the conclusions, the following recommendations are made:

1) Teachers must be encouraged in applying varied strategies especially computer-aided instruction in teaching operations in polynomials to enhance performance of the students in solving operations in polynomials.
2) Teachers must go to seminars that involve the use of computer in instruction.
3) Teachers should make different kinds of computer-aided games for different topics in Mathematics for livelier discussion during lesson proper.
4) Parents should encourage their children to give time for studying the lessons since operations in polynomials is difficult.
5) Parents should encourage their children to play educational games instead of games that are remotely related to their child's studies.
6) The CAG should be played by students even long after the discussion in operations in polynomials to enhance their knowledge and skills in solving operations in polynomials.
7) The CAG should be used by the teachers in their teaching to help develop and improve students' understanding about how to solve operations in polynomials.
8) The continuous use of CAG is needed due to rapid growth of technology in this era. Also, the teachers are encouraged to make similar presentations or programs of CAG that can be used in any topic in Mathematics not just in operations in polynomials in which it can help students' performance.
9) Researchers may conduct another study similar to present study in other schools, district, or division in a broader scope.

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