Game-based Activity: The Effect on Students' Learning in Mathematics

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Abstract

The study was a quasi-experimental non-equivalent control-group research design conducted to investigate the effect of game-based design activities on students' achievement scores in Algebra, more specifically it aims to enhance computational skills of the students in solving quadratic equations by factoring. The participants of the study were the two sections of the junior high school students. One section was assigned as a control group who was exposed to traditional approach with usual motivation and activity given to them while the other one was an experimental group which was exposed to online game activity called "Quadratic Rush". A post-test was administered to the control and experimental groups after the sessions. The study reveals that the scores of the respondents from post-test are higher than their pre-test. The pre-test scores of the students from the control and experimental group are not statistically significant. The results also revealed that the students exposed a game based activity obtained higher achievement scores compared to the students who were exposed to traditional activities, it is implied that the test of the students has a significant effect in terms of students' scores and "Quadratic Rush" was an effective method to improve computational skills of the students in solving quadratic equations by factoring. It is suggested to increase the maturity of the study in terms of implementation of the treatment to the respondents. For teachers to incorporate games in teaching other concepts in Mathematic and develop their own game prototype that is suitable to the learner's interest and needs. Doing physical games is recommendable if opportunity permits.

Keywords:game-based activity, learning, mathematics

1. Main text

According to recent researches, lessons in Mathematics promotes negative implication to students as well as low performance because of too much lecture and writing activities. (Kankia, 2008 as cited by Orim & Ekwueme, 2011).

Instructional techniques by the teachers as viewed for the past decades serve as one of the key components in the learning process, this means that teacher's strategy in giving instruction is beneficial for student's understanding (Rondina & Roble, 2019). As stated by Way (2011), learning by doing especially through games can be one of the very effective ways in learning a specific concept.

Learning mathematics in a traditional set up is claimed to be boring¬- seatwork and board works are followed by the discussion. That is the reason why students sometimes lose their attention in learning

mathematics. Learners have a short span of attention especially if they receive the information by mere listening. Hence, the understanding of their mathematical computation is shallow. These ideas encouraged the researcher to conduct this study which will help math teachers to innovate with a new approach. This will then teach students better than in the traditional way. One of the difficulties of students is factoring equations. It is a primary mathematical concept, and students need to first learn the basics before learning this complex concept. Not knowing the basics may be the reason for the students to have difficulty in computing and factoring quadratic equation.

The objective of this study is, then, to enhance students' learning in Mathematics using game-based activity, particularly in factoring and computing quadratic equations.

Conceptual Framework

It will test the difference between the achievement scores of the students in Algebra. It include administration of test those group who will received treatment and not. This study aims to enhance students' learning in Mathematics using game-based activity, particularly in factoring equations in computing quadratic equations. Appropriate guidance and learning resources, anchored on the theory of Bruner (1960, 1966, 1996) which avers that scaffolding help students perform better in their mathematics classes. Students who are more inclined to perform well in mathematics classes may help the class by serving as guides to the others in doing exploratory activities. According to Ord (2012), a theory introduced by Dewey implicated that the learning process will be much more effective if students are given first-hand and real-life based activities. Mathematical games will be utilized in this study to enhance the student computational skills, mathematical games which are played personally by the students themselves. With the previously mentioned strategy, students are able to easily understand and remember mathematical concepts incorporated in the game. Through the personal experience of winning and losing life-like based mathematical games, students are more likely to remember important mathematical concepts. After all, games are very attractive and engaging on the part of the students because they do not only promote the development of problem solving skills, at the same time, they also encourage students to interact with their peers during the game process.

Research Problems

The purpose of this study is to enhance students' achievement scores in algebra particularly in factoring equations using game-based activity. It will answer the following questions:

1. Is there a significant difference between the pre-test and post-test means of the control and experimental group in terms of students' Mathematics scores in factoring equation?
2. Is there a significant difference between the pre-test means of the control and experimental group in terms of students' Mathematics scores in factoring equation?
3. Is there a significant difference between the post-test means of the control and experimental group in terms of students' students' Mathematics scores in factoring equation?

Hypothesis

Ho: There is no significant difference between the students' scores in factoring equations with and without using game-based activity

Ha: There is significant difference between the students' scores in factoring equations with and without using game-based activity

Literature

The aim of education is to make the youth ready for lifelong learning (Divjack & Tomic, 2011). As digital technology spreads through all the parts of people's lives, it is crucial to say that technology is also a part of education. A growing number of classrooms are now using technology as an aid in learning (Rosen & Beck-

Hill, 2012). The goal of using technology as a means in education is to create learning environments that are appealing to the learners, making it easy for them to understand and recall curriculum content (Rosen & Beck-Hill, 2012) Moreover, technology serves as an aid to educators in making learning instructions suitable to the learners. Differentiation means "offering learners with different opportunities to acquire content; to processing, creating, and making sense of ideas" (p. 228). (Thiruchelvam, 2018)

Mathematics educators encourage learners to take-part in the teaching-learning process. It is seen when the learners focus during the teaching of mathematical concept and their test scores are high (Rondina & Roble, 2019).

One of the key factors that consistently affect mathematics test scores is 'opportunity to learn', either measured as the total of curriculum covered or the percentage of the items of the test that was taught. (Reynolds & Mujis, 2010 as cited by Brophy & Good 1986; Hafner 1993; Herman & Klein 1996).

Learning mathematics may be hard for some students, but introducing different teaching styles and activities may increase the engagement in the learning process. This study expands the capability of learners with the help of their peers. This also adds value to the game based-learning to elaborate its goals in the learning process.

Mathematics is not only about calculations; it is also an art. One latest study has found that some educators surveyed stated that there is no time intended for playing in their kindergarten classes (Miller & Almon, 2009). This outlook is connected with the expectations that young learners should have a strong foundation in literacy and mathematics. As a result, their playtime has decreased and eventually was replaced with academically focused activities. For example, one report revealed that for every 30 minutes of play, kindergartners are engaged in two to three hours of lessons (Miller & Almon, 2009) nevertheless, time spent in lessons and in playing do not have to be always equal. Games and play can give young learners opportunities to explore, learn, and develop their skills in mathematics. {Ramani, G. B., & Eason, S. H. (2015)}

Game-based learning include instruction with authentic game experience (Cicchino, 2015 as cited by White & McCoy, 2019). Game-based learning caught the attention of educators who want to show the qualities of computer games as observed by some to be an effective approach for teaching and learning. Salam, Hossain, & Rahman, (2015)

The goal of game-based-learning is not merely about fun and excitement, though it is part of it, but also it is considers the high applicability of mathematics. Giving an enjoyable activity yet serious to the learners also allows the transfer of learning. According to Dele-Ajayi, Sanderson, Strachan, & Pickard, (2016), learners play digital games during childhood and adolescence period. Issues and debates sparked whether teenager learners should still be exposed to digital games. Researchers predict that technology-enhanced learning will improve with the help of educational games (serious games). Serious games may be built on educational theories, but these games can be boring to some learners. Analyses of serious games state that serious games do not provide an entertaining experience to the learners. On the other hand, a high level of commitment and engagement by the learners is very important to have a strong learning environment.

According to Paraskeva et al. (2010, p. 499), the use of games is a ―fun, engaging, motivating, interesting and encouraging way of teaching. They also state that games have potential for teaching complex new.

Paraskeva et. al. 2010, as cited by Afari, 2012, stated that using games in teaching is fun, motivating, interesting, engaging, and encouraging one. It also gives potential for teaching complex information to students. They believed that both academic performance and interpersonal relationships are likely to be enhanced if teacher incorporates games in teaching.

According Romero, Usart, Ott, Earp, de Freitas, & Arnab (2012) the use of Game Based Learning (GBL) has both positive and negative aspects that need to be addressed in order to sustain the success of learning goals and knowledge formation.

Research Design

The researcher will used quasi-experimental non-equivalent control-group design. According to Creswell, 2008, this design is the popular approach to quasi-experiments, where in the samples are 2 groups, one for experimental group, that will receive treatment which is game-based activity and the other section will serve as the control group which will be given traditional approach of activity; worksheet that is related in factoring equations.

Sampling and Participants

The study will be conducted with two sections of Grade 9 students in the Theresian School of Cavite in Bacoor City, Cavite, Philippines. There are 22 students assigned as control group who was exposed to traditional approach with usual motivation and activity given to them like e-board works while the experimental group are composed of 25 students which was exposed to game activity called as "Quadratic Rush"activity in factoring quadratic equation.

Instrumentation

The data of the study will be collected using a teacher-made questionnaire. The questionnaire is composed of a twenty-item that will meet the most essential learning competencies and objectives of factoring quadratic equations using table of specification.

Integration of the game. The researcher will be using an online game-based activity called "Quadratic Rush". For the experimental group. Quadratic Rush was designed to assist algebra and pre-algebra students in gaining skills which will be useful when they begin factoring quadratic equations. The game can be played by any student who has an understanding of addition and multiplication. The game is composed of six levels, each level consists of five questions, and the player has 60 seconds to complete each level. The first two levels do not include any negative numbers. The player's score is based on two factors: how few mistakes are made, and how quickly the questions are answered. More points are awarded for more difficult questions, so starting at a higher difficulty level may result in a higher score. As you progress through the six levels, the answers may increase in size, making them more challenging to solve.

Data Analysis

The treatment will start after the pre-test. During the treatment period, the teacher will discuss the concepts related to factoring quadratic equations and after the discussion a series of activities such as seat works, board works and assignments will be given to the control group while game-based activity called "QUADRATIC RUSH" ¬will be conducted with the experimental group. The purpose of the game is to assist algebra and pre-algebra students in gaining skills which will be useful when they begin factoring quadratic equations. The game can be played by any student with an understanding of addition and multiplication.

A post-test was administered to the control and experimental groups after the sessions. To compare the pre-test and post-test scores of the students of the control and experimental group paired sample T-test was used and T-test for independent means to analyse the data to look for the significant difference between the post-test scores of both control and experimental group.

The data will be analysed using SPSS (Statistical Product and Service Solutions) statistical software. This will help the study in comparing the scores of the students from both control and experimental group to determine its significance.

Results

1. Is there a significant difference between the pre-test and post-test means of the control and experimental group in terms of students' Mathematics scores in factoring equation?

Table 1. Comparison of the result of the pre-test and post-test of the control group

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	CGPretest - CGPosttest	-5.22727	2.48676	.53018	-6.32984	-4.12470	-9.859	21	<.001

The table shows the p-value of .001 which means that the pre-test and post-test of the control group is statistically significantly different. The scores of the respondents from post-test are higher than their pre-test.

Table 2. Comparison of the result of the pre-test and post-test of the experimental group

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	EGPretest - EGPosttest	-5.76000	1.53514	.30703	-6.39368	-5.12632	-18.760	24	<.001

The table shows the p-value of .001 which means that the pre-test and post-test of the experimental group is statistically significantly different. The scores of the respondents from post-test are higher than their pre-test.

2. Is there a significant difference between the pre-test means of the control and experimental group in terms of students' Mathematics scores in factoring equation?

Table 3. Comparison of the result of the pre-test of the control and experimental group

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pretest	Equal variances assumed	2.143	.150	-.354	45	.725	-.28727	.81120	-1.92111	1.34657
	Equal variances not assumed			-.348	39.018	.730	-.28727	.82539	-1.95676	1.38221

The table shows that the scores of the pre-test of the control and experimental group are not statistically significantly different with the p-value of 0.725 (equal variances assumed) and 0,730 (equal variances not assumed).

3. Is there a significant difference between the post-test means of the control and experimental group in terms of students' students' Mathematics scores in factoring equation?

Table 4. Comparison of the result of the post-test of the control and experimental group

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Posttest	Equal variances assumed	3.589	.065	-7.884	45	<.001	-6.04727	.76702	-7.59212	-4.50242
	Equal variances not assumed			-7.680	35.349	<.001	-6.04727	.78745	-7.64531	-4.44924

The analysis revealed that the students exposed to quadratic rush – a game based activity obtained higher achievement scores compared to the students who were exposed to traditional activities inside the classroom like e-board works with the p-value of 0.001 which is less than alpha of 0.05. The higher scores of the students in the experimental group was attributed to the game activities that the students were exposed.

The result implied further that mathematical game activities have a positive effect on the students' achievement score in mathematics particularly in factoring quadratic equations. To support this result, Rondina & Roble (2019), stated that mathematics game-based design activities established a positive influence on students' learning gains in Algebra. The students' experiences while playing may lead them to recall the mathematical concepts used in the games.

Summary

The study was a quasi-experimental non-equivalent control-group research design conducted to investigate the effect of game-based design activities on students' achievement scores in Algebra, more specifically it aims to enhance computational skills of the students in solving quadratic equations by factoring. The participants of the study were the two sections of the junior high school students at Theresian School of Cavite, Bacoor City, Cavite, Philippines. One section was assigned as a control group who was exposed to traditional approach with usual motivation and activity given to them like e-board works while the other one was an experimental group which was exposed to online game activity called "Quadratic Rush". A post-test was administered to the control and experimental groups after the sessions.

First, the study reveals that pre-test and post-test of the both control and experimental group is statistically significant. The scores of the respondents from post-test are higher than their pre-test. Second, the comparison between the pre-test scores of the students from the control and experimental group are not statistically significant. Third, the results also revealed that the students exposed to quadratic rush – a game based activity obtained higher achievement scores compared to the students who were exposed to traditional activities inside the classroom like e-board works. Lastly, in the overall analysis of the data, it implied that the test of the students has a significant effect in terms of students' scores.

Conclusion

Based on the findings, mathematical game-based design activity "Quadratic Rush" was an effective method to improve computational skills of the students in solving quadratic equations by factoring. It tells that the null hypothesis of the study was rejected, meaning the difference between the post-test scores of the control and experimental group is statistically significant.

According Rondina & Roble (2019), traditional teaching and teacher-centered education are not replaced by technology-enhanced classroom practices, instead this technical advancements have offered teachers and students the ability to build an entirely new learning opportunity in mathematics by greatly widening the variety and complexity of potential classroom activities.

Recommendations

To enhance students' achievement scores in Algebra particularly in computing quadratic equations by factoring using game-based activity, the following recommendations are proposed. To increase the maturity of the study in terms of implementation of the treatment to the respondents. To conduct a pilot study first to test the consistency of the test given to the students. In addition, Mathematics teachers may incorporate games in teaching other concepts in Mathematic, specifically, those higher concepts in Mathematics. Teachers may develop their own game prototype that is suitable to the learner's interest and needs. Doing physical games is recommendable if opportunity permits. It's also better if we do not limit the games in individuals and explore games that promotes cooperation and collaboration. Lastly, the applicability of the game base wouldn't be intended to enrich the instruction but also to further enhance the delivery of the preliminary activity and the assessment. This will make the entire delivery of the lesson more interactive and student-centered for new generation of education.

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