T-Game in Teaching Mathematics

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Abstract

The study focused on the effect of using T-game in teaching Mathematics among 80 Grade VII Students of Tabok National High School in the Mandaue City Division, Tabok Mandaue City for the 2014-2015 school year. Specifically, it looked into the pre-posttest level of performance among the control group: students taught using the mandated Learner's Material and the experimental group: students taught using the T-Game in teaching mathematics. Aside from the academic performance of the two groups, both groups' attitude was collected to correlate students' performance to their attitude in the learning process. Moreover, the career preferences of both groups were collected before and after the conduct of the study.

It was established that the use of T-game has significant improvement on the experimental group which achieves higher scores compared to the control group. However this significant improvement was only evident in the Knowledge and Process level of assessment. It was found out that the T-game provides a positive attitude for students in learning mathematics. In effect, male students tend to consider choosing Science and Mathematics related careers. The result of the study affirms Kiili's Experiential Gaming Model from Kolb's Experiential Learning Theory.

It is therefore recommended to use the T-game in teaching Mathematics. This game creates an environment of active learning and full involvement of the students in grasping the necessary competencies. Though this may apply to this institution, it is highly regarded to carefully study the correlated factors and that further related studies with a wider scope of population be pursued.

Keywords: T-Game, attitude, Kiili's Experiential Gaming Model, mathematical achievement

Introduction

Mathematics education in the Philippines continues to face challenges, as reflected in international and national assessments. The country ranked 41st out of 45 in the 2003 Trends in Mathematics and Science Study (TIMSS), and high school math scores in the National Achievement Test (NAT) have steadily declined, highlighting the urgent need for educational reforms (Quismundo, 2013).

Research identifies ineffective instructional strategies, inadequate teacher competency, and low student motivation as key factors affecting performance (Saritas & Akdemir, 2009). Studies also suggest that students' attitudes toward math significantly impact their achievement, with many avoiding math-related courses due to anxiety and lack of engagement (Mullis et al., 2012; Ramseier, 2001).

This study explores the integration of T-Games in math instruction to enhance student motivation and performance. Originally designed for management training, the T-Game is a card-based activity that fosters teamwork, critical thinking, and problem-solving (Hill, 2006). Applying this interactive approach in the classroom aims to shift students' perceptions of math from a rigid subject to an engaging and collaborative learning experience.

Student engagement is crucial for academic success and positive classroom behavior (Harris, 2008; Willms, Friesen, & Milton, 2009). Preliminary observations suggest that game-based learning increases

participation and enthusiasm. This study seeks to provide empirical evidence on the effectiveness of T-Games in improving math learning outcomes, ultimately encouraging students to pursue math-related fields.

Theoretical-Conceptual Framework

This study is grounded in Kiili's Experiential Gaming Model, which links gameplay with experiential learning to facilitate a flow experience (Kiili, 2005; Staalduinen & de Freitas, 2014). The model conceptualizes learning as a cyclic process derived from direct experience within the game world, closely aligning with Kolb's experiential learning cycle (Kolb, 1984). Kiili emphasizes that learning occurs through cognitive construction via action and practice in the game world, independent of social interaction.

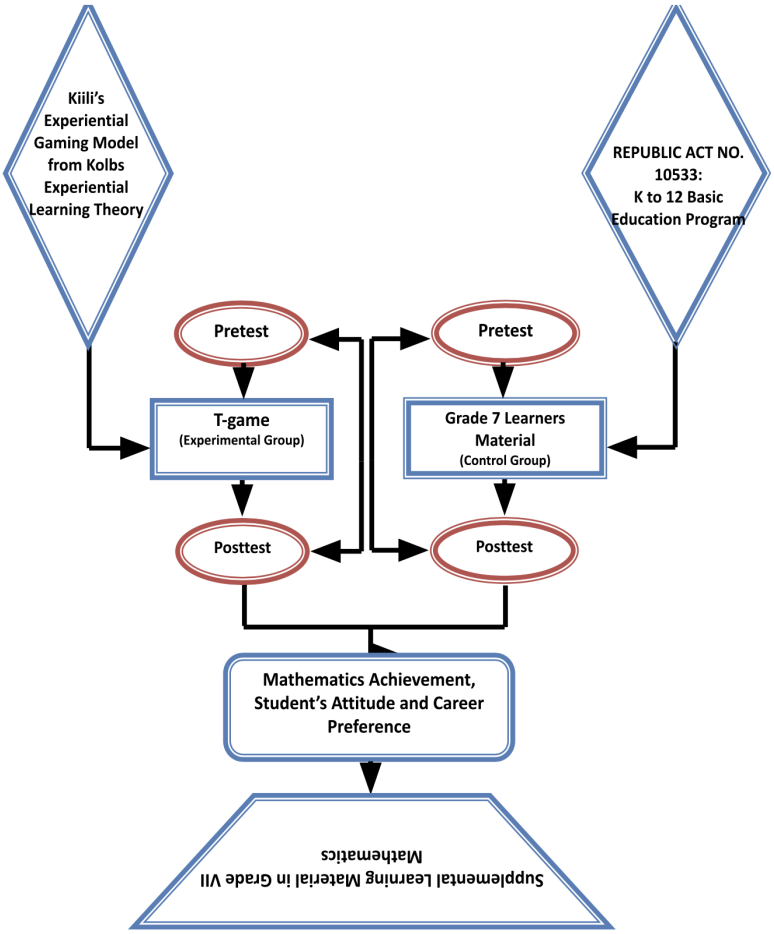

Figure 1: A Schematic Diagram of the Theoretical and Conceptual Framework

Figure 1 illustrates the study's conceptual framework, depicting the relationship between experiential gaming, motivation, and academic achievement.

The model consists of two key cycles: the gaming cycle, which describes how players experience learning through gameplay, and the design cycle, which guides the development of educational games (Staalduinen et al., 2014). Effective educational game design should integrate key flow antecedents, such as challenges matched to skill levels, clear goals, structured feedback, a sense of control, and an engaging narrative (Kiili, 2006). Reflection on feedback allows players to refine their strategies, ultimately improving problem-solving skills and subject mastery. In digital learning environments, reflective tools such as intelligent tutors and conversation aids further enhance learning (Siemens, 2004; Leemkuil, 2006).

This study utilizes the T-Game, adapted from Rossiter's (2007) research on game-based mathematics instruction. The T-Game is a team-based card activity requiring students to solve a sequence of interdependent mathematical problems to determine the final value of T. To progress, teams must correctly answer each step in the sequence, encouraging collaboration, critical thinking, and strategic problem-solving. Hints are available at the cost of point deductions, reinforcing decision-making skills.

The integration of T-Games aligns with Self-Determination Theory (SDT) by Ryan and Deci (2002), which posits that motivation arises from fulfilling psychological needs. SDT suggests that students engage in activities when they find them purposeful and rewarding, directly influencing their learning outcomes. By incorporating game-based learning, this study aims to enhance student motivation and engagement, ultimately improving mathematics performance.

Statement of the Problem

The study determined the effect of using T-Game in teaching Mathematics among Grade VII Students of Tabok National High School for School Year 2014-2015.

Specifically, answers to the following queries will be sought:

1. What is the pre-posttest level of Mathematics performance in the control and experimental group?
2. Is there a significant mean difference in the pre-posttest mathematics Performance in the control and experimental groups?
3. Is there a significant mean gain difference in the pre-posttest mathematics performance of both groups?
4. What is the students' attitude of math learning after being exposed to T- Game?
5. What is the career preference of the control and the experimental groups of the study?
6. What experiential learning activities can be designed based on the results of the study?

Statement of Hypotheses

The following null hypotheses will be tested at 0.05 level of significance.

Ho2: There is no significant mean difference in the pre-posttest mathematics performance among the control and experimental group.

Ho3: There is no significant mean gain difference in the pre-posttest mathematics performance among the control and experimental group.

Methodology

Research Method

A controlled, quasi-experimental study was used to examine the effect of using T-Game in the teaching of Mathematics to the Grade 7 students of Tabok National High School in Mandaue City for S.Y. 2014-2015. The pairwise matching was done in terms of gender and mathematics grade in the first quarter. There was a comparison of results obtained from an experimental group against the control group, with the use of T-Game in teaching as the independent variable whose effect was tested. The T-Game, a researcher-modified teaching method was used to motivate the students' attitude towards Mathematics learning and influence students' preference in math related courses.

Research Respondents

The subjects in the study were the 80 Grade 7 students of Tabok National High School in Mandaue City for S.Y. 2014-2015. There were 40 students for the control group who all belong to Grade 7-Mahogany class and 40 students for the experimental group who were from Grade 7-Molave.

Since the two sections were heterogeneous classes, the researcher conducted a pairwise matching in terms of gender and mathematics performance in the first quarter to make sure that these factors will not affect the result of the study.

Section	No. of Boys	No. of Girls	Total	Schedule/Time
7-Mahogany (Control Group)	20	20	40	M, Tue, W & Th 2:00-3:00
7-Molave (Experimental Group)	20	20	40	M, W, Th & F 10:00-11:00

Table 1: The Respondents of the Study

Table 1 shows the composition of respondents in both control and experimental groups. It also projects the time and schedule on the conduct of the study.

Research Environment

This experimental study was conducted in Tabok National High School in Tabok, Mandaue City.

Established in 2002, Tabok National High School was created when Tabokanons sought the need to have its own barangay high school. This is now one of the public secondary schools in Mandaue City. It is committed to mold young Tabokanons to become successful in whatever endeavor they wish to pursue. From its humble beginnings with only 121 students, now it has grown to a population of more than 700 with 15 instructional rooms and one computer laboratory among others. Each room is composed of a heterogeneous group of students.

The school has four sections of Grade 7. The sections are named after the Philippines famous trees such as Acacia, Molave, Narra and Mahogany. Each section is composed of about 50 students.

Research Instrument

The main instrument in the study was the written Pre-Posttest to be given to both control and experimental groups. The Periodical Test for the Third Quarter served as the pre-posttest.

To determine how well students were motivated in the learning process, students were asked to complete a certain phase and explain it in a few sentences on how they feel about the game in the learning process.

Lastly, Career Preference Test, an online assessment tool that was used to predict future career preferences of students as to Math-related courses.

Procedure

At the onset, a permission to validate the instruments was sought from the Schools Division Superintendent of Mandaue City and the School's Principal of Tabok National High School. Two sections of the Grade 7 were to answer the Course Motivation Survey, the Career Preference Test and the pretest. Using the Kuder-Richardson formula for obtaining the Coefficient of Reliability, the pretest obtained a coefficient reliability of 1.00. The result of the validation was used to improve the version of the instrument.

With the permission of the Schools Division Superintendent of Mandaue City and the School's Principal, the study was conducted in the third grading period. The control group, Grade 7-Mahogany was taught using the Grade 7 K to12 Learners Material for the third quarter while the experimental group, Grade7-Molave was taught using the T-Game with the same competency. The schedule was reflected in Table 1.

Statistical Treatment

The following statistical treatments were used in the following problems:

Problems 1. In order to determine the pretest and posttest level of mathematics performance of both the control and the experimental group, the One-Sample T-Test was used. Using this statistical tool, if the results will show that the actual mean reached or exceeded the hypothetical mean, then it will be assumed that the grade 7 students successfully meet the standard set by the school, which is 75% of the total number of the mean score of the Pre-Posttest.

Problem 2. To determine the Pre-Posttest mean gain difference in each of the control and the experimental group, the T-test for Dependent Means was used. Using this statistical tool, it will be assumed that the respective groups obtained a higher mean gain after posttest, they are said to have responded more positively to the treatment given to them. In this study, the treatment points to the methods of teaching in the teaching-learning process.

Problem 3. To establish whether there will be a significant mean gain difference between the control and the experimental group, the T-test for the Independent Means was used. If it occurs that the experimental group's mean gain will be higher than that of the control group, then there will be a sufficient reason to conclude that the use of the T-Game in teaching Grade 7 mathematics proves to be more effective in helping the students to understand the difficult concepts in Mathematics; thereby, encouraging them to interact more actively and perform math operations in an easier and faster way.

Results and Discussion

The study's most significant breakthrough is the remarkable improvement in the experimental group's mathematical performance, demonstrating the effectiveness of the T-game as an innovative instructional tool. The results consistently indicate that students exposed to the T-game approach showed greater gains in mathematical competency, particularly in problem-solving, equation analysis, and conceptual understanding.

Pretest Performance Level of Grade VII Students

Data presents the pretest performance of both the control and experimental groups. Neither group met the passing score across all levels of assessment, indicating an overall below-average proficiency in solving linear equations and inequalities. This suggests that students lacked prior exposure to these concepts. Importantly, the comparable pretest scores confirm that both groups started at the same level, ensuring that the experimental process was unbiased.

Posttest Performance Level of Grade VII Students

Data reveals a striking contrast between the control and experimental groups following the intervention. The control group exhibited minimal improvement, with only the female students in the Knowledge level surpassing the passing score. In contrast, the experimental group significantly outperformed their counterparts, with both male and female students exceeding the passing score in the Knowledge level and male students achieving above-average performance in the Process level. These findings highlight that active engagement through the T-game substantially enhanced students' mathematical skills.

Pretest and Posttest Difference Among Grade VII Students

Table 5 illustrates the improvements in both groups. While the control group demonstrated some progress using the handbook, the experimental group showed a more substantial increase in posttest scores across all levels. This validates the T-game's capacity to foster a deeper understanding of mathematical concepts, as it integrates problem-solving with interactive learning, motivating students to engage more actively.

Table 5
The Pretest and Posttest Difference Among Grade VII Students in Mathematics of the Experimental Group

Gender	Assessment Levels	No. of items	Pretest Score (SD)	Posttest Score (SD)	Mean Difference	*t* – value (*P* –value)	Decision
Male	Knowledge	17	7.250 (1.682)	14.600 (1.603)	7.350	14.289 (0.000)	*Significantly Improved*
	Performance	12	4.150 (1.814)	9.350 (1.531)	5.200	11.113 (0.000)	*Significantly Improved*
	Understanding	12	2.750 (1.517)	7.900 (1.774)	5.150	12.125 (0.000)	*Significantly Improved*
	Product	7	1.250 (1.020)	3.600 (1.353)	2.350	6.714 (0.000)	*Significantly Improved*
	Totality	**48**	**15.400 (3.589)**	**35.450 (3.486)**	**20.050**	**31.603 (0.000)**	*Significantly Improved*
Female	Knowledge	17	8.850 (1.785)	14.650 (1.725)	5.800	10.186 (0.000)	*Significantly Improved*
	Performance	12	5.150 (2.007)	8.350 (1.927)	3.200	6.082 (0.000)	*Significantly Improved*
	Understanding	12	2.350 (1.565)	7.850 (1.663)	5.500	13.098 (0.000)	*Significantly Improved*
	Product	7	1.000 (0.858)	4.200 (1.436)	3.200	8.107 (0.000)	*Significantly Improved*
	Totality	**48**	**17.350 (4.475)**	**35.050 (4.828)**	**17.700**	**13.766 (0.000)**	*Significantly Improved*

* *Significant at 0.05 level*

Comparative Mean Gain of Male and Female Students

Table 7 compares the mean gains of male and female students in both groups. The experimental group, particularly male students, exhibited significantly higher mean gains, suggesting that game-based learning is particularly effective for active learners. While female students also benefited, their improvement was more pronounced in the Knowledge and Product levels. This aligns with existing research indicating that males generally favor competitive and strategic play, while females prefer interactive but less competitive formats.

Table 7
The Mean Gain Difference of Female Students' Performance in Mathematics Between the Control and Experimental Group

Gender	Assessment Levels	Tests	Control Group		Experimental Group		t – value (P –value)	Decision
			Mean Score	Mean Difference	Mean Score	Mean Difference		
Females	Knowledge	Pretest (SD)	9.700 (1.949)	3.800	8.850 (1.785)	5.800	2.811 (0.008)	*Significantly Different*
		Posttest (SD)	13.500 (1.701)		14.650 (1.725)			
	Process	Pretest (SD)	5.700 (1.720)	1.900	5.150 (2.007)	3.200	1.853 (0.072)	*Not Significantly Different*
		Posttest (SD)	7.600 (1.847)		8.350 (1.927)			
	Understanding	Pretest (SD)	2.050 (1.234)	3.950	2.350 (1.565)	5.500	1.975 (0.056)	*Not Significantly Different*
		Posttest (SD)	6.000 (2.847)		7.850 (1.663)			
	Product	Pretest (SD)	0.850 (0.745)	1.600	1.000 (0.858)	3.200	2.715 (0.010)	*Significantly Different*
		Posttest (SD)	2.450 (1.877)		4.200 (1.436)			
	Totality	Pretest (SD)	**18.300 (3.658)**	**11.250**	**17.350 (4.475)**	**17.700**	**3.409 (0.002)**	***Significantly Different***
		Posttest (SD)	**29.550 (6.117)**		**35.050 (4.828)**			

* Significant at 0.05 level

Attitude Towards Mathematics Learning

Students from both groups expressed enjoyment in learning, albeit in different ways. The control group appreciated the structured activities in the handbook, while the experimental group found excitement and engagement through the T-game. However, challenges persisted, such as boredom due to repetitive activities in the control group and classroom noise in the experimental group. Despite these concerns, the study supports the idea that interactive, game-based learning fosters a more positive attitude towards mathematics.

Career Preferences Before and After the Study

Collected indicates a notable shift in career preferences among the experimental group. Before the intervention, male students leaned towards Education and Training, Health Sciences, and Hospitality and Tourism. After exposure to the T-game, many shifted towards Science, Technology, Engineering, and Mathematics (STEM) fields. This suggests that the T-game not only improved mathematical performance but also positively influenced students' career aspirations in math-related fields. Female students, however, showed minimal change in career preference, reflecting their consistent inclination towards education and health-related professions.

Conclusions

The findings of this study demonstrate that the T-game is a highly effective tool for teaching Grade VII Mathematics. By integrating the T-game into instruction, students actively engage in the learning process, fostering a more dynamic and participatory classroom environment. The game cultivates a positive attitude among students, enhancing their comprehension and retention of mathematical concepts. As a result, their overall mathematical achievement improves, particularly at the Knowledge and Process levels of assessment. However, the study also reveals that this improvement does not extend significantly to higher-order thinking skills. Notably, the study found that male students who participated in the T-game exhibited a shift in career preference toward Science and Mathematics-related fields. These findings align with Kiili's Experiential Gaming Model, rooted in Kolb's Experiential Learning Theory, which emphasizes how game-based learning

fosters experiential learning. By immersing students in an interactive game environment, the T-game enables learners to construct knowledge through hands-on practice and engagement, ultimately enhancing their educational experience.

Recommendations

From the findings and conclusion made about the present study, the following recommendations are respectfully suggested.

a.) There should be variations in the groupings when implementing T-games as a springboard to the lesson. Change the group's composition from time to time for better interactions.

b.) Teachers should be constantly monitoring student's participation to avoid chaos and misunderstanding within the group when facilitating the game.

c.) Modify the rules of the game and strictly impose them. Instead of an individual assignment of an item for them to answer, let them work by pair. This encourages them to collaborate with others.

d.) Teachers must design a strategic way to minimize waste of time in giving the correct answer to each group of the T-game so as to focus on identifying the difficulties of the students in a certain lesson.

e.) Use the made experiential T-Game in teaching Mathematics.

f.) Most importantly, always reward students with their corresponding achievement such as points or goodies for them to be more motivated. Always remind them that the goal of the game is to keep them alive and motivated and not merely on winning.

Further Recommendation for the Future Researcher

The researcher further suggests the following:

a) This study is limited only to an exclusive locale so it is strongly suggested to include a wider scope of population.

b) If time and resources permit it is also recommended to conduct a longitudinal study to use T-game in the teaching-learning process

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