Action Research to Develop Mathematical Learning Activities by Using Games

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Abstract: The objectives of this research were 1) to design and develop mathematical learning activities by using games and 2) to study the results of mathematics learning activities by using games. There were two groups of population. The first group was the fourth year mathematics program with a number of 24 people who are responsible for the design and develop mathematical learning activities by using games. The second group consisted of 81 students in Mathayomsuksa 1, which were used to study the results of mathematics learning activities by using games. The research instruments were operational research processes, mathematics achievement test and the teamwork measures. The statistics used for data analysis were mean, standard deviation, t-test dependent and content analysis.

Index Terms: Game-based mathematical learning activities, mathematics achievement, teamwork, operational research

1. Introduction

Mathematics plays a crucial role in the success of 21st century learning as it empowers humans to be creative, logical, systematic and structured. It can also be used to analyze a problem or a situation very carefully and thoroughly. They are used to predict, plan and make decisions, to solve problems correctly and to apply them in real life effectively. Mathematics is also a tool for the study of science, technology and other sciences, which is the foundation for the development of national human resources to be of high quality and to develop the national economy to be on par with the international community. Mathematics education needs to be developed continuously in order to be modern and in line with the economic, social conditions and scientific and technological knowledge with rapid progress in globalization [7].

Operational research is an operation that reflects self-performance in a helical path, which includes plan, action, observation and reflection. This research requires a participant in the practice feedback process to achieve its development and improvement [3]. Using games in mathematical learning plays an important role and contributes to the development of knowledge. Games are one of the methods that can be used in teaching well. The instructor has to create a scenario where the learners play under certain rules that will result in the form of losing or winning [8].Using games in teaching or using games as a means of teaching and learning will help reduce stress for students and make fun of them and create a relaxed atmosphere while developing student achievement. Therefore, the game is considered a good way that should reduce the boredom in studying and stimulate more interest in studying. Plus, the game promotes teamwork, which is an essential part of interpersonal skills and the responsibility for planning collaboration.

Therefore, the researcher is interested in action research to develop mathematical learning activities using games to develop mathematics achievement and teamwork of students, which is an important part of working with others and is a guideline for the development of the teaching and learning of mathematics to be more effective.

2. Research Objectives

1. To design and develop mathematical learning activities using games.

2. To study the results of using math learning activities using games.

3. Research Methods

A. Populations

The population was divided into 2 groups: the first group was 24 students in the mathematics program of the 4th year, who work together to develop math learning activities using games. The second group consisted of 81 students in Grade 13 of Phikrai Witthaya School, Khlong Phikrai, Phran Kratai District, Kamphaeng Phet, a group used to study the results of math learning activities using games.

B. Research Instruments

1. Mathematics learning activities using games include course description of numbers and algebra, measurement and geometry, statistics and probability. There were 3 learning activities; each activity has 5 steps which were

Step 1 – Content Preparation: Preparation of content, games and simple questions which are subject matter questions the students have learned and how to score in games and learning materials

Step 2 – Team Building: Instructors must organize a mixed team of learners in terms of gender and ability in order to be able to learn by performing activities according to their instructions or worksheets.

Step 3 – Learning: Instructor should guide learning methods, planning teams and competitions. Each team member must work together to carry out the activities in order or worksheet, beginning with the preparation so that all group members were ready for the competition, assessing the knowledge and understanding of the content of the team members, then having the members explain further on issues that some members still do not understand.

Step 4 – Competition: Instructor must introduce the competition to learners by arranging for students or representative members of each team to attend the competition. The instructor introduced the game by explaining the purpose and rules of the game. All members or learners started the game together with the same set of questions. The instructor walked up to various tables to answer any questions or concerns. At the end of the match, each table would review the score, ranking the results and awarding bonus points. The team brought together their individual bonus points for the total team score. The team with the highest total score will be recognized as the winning and runner-up team, respectively.

Stage 5 – Team Achievement Recognition: The instructor will announce the results of the competition and publish it to the public in various ways including awarding honorable mention.

2. Form of mathematics achievement measurement was a multiple-choice exam with 30 items consisting of validity by finding the consistency between the question and the objective (IOC) was between 0.67 - 1.00, confidence factor based on the Kuder-Richardson Formula (KR-20) was 0.76, difficulty (p) was between 0.47 - 0.77 and discriminant power (r) was between 0.20 - 0.53.

3. Form for measuring teamwork uses 10 Five-Point Likert-Type Scale, which were: validity by finding the consistency between the question and the objective (IOC) was between 0.67 - 1.00 and the confidence value of the Cronbach's alpha method or the alpha coefficient. (α – Coefficient) was equal to 0.81.

C. Data collection

There were 4 steps to data collection as follows.

Planning steps were as follows

1. Meeting with students to find ways to develop mathematical learning activities using games and organizing math learning activities using games, along with assigning each group to design learning activities together

2. Students took the activities generated from Step 1 to practice using simulation scenarios and had the remaining students as the learner and assessor with the researcher

3. After the student's experimental activity had been completed, students would complete the mathematical learning activities using games based on feedback from assessors and researchers

4. Coordinating to school administrators and teachers to organize activities for determining the date, time and place of the activity

Operation steps were as follows

Perform math learning activities using games in course description of number and algebra, measurement and geometry, and statistics and probability. This would be separated by course description organized as a learning base. Students circulate to participate in activities in each base, which is mentored by the student base.

The observation steps were performed as follows**.**

1. Students take a form of mathematical academic achievement measurement.

2. Students take a form of measure of teamwork.

The process of reflection was performed as follows**.**

1. Students and researchers would meet together after organizing mathematical learning activities using games, in terms of activity, defects and important points for improvement.

2. The students' meeting results and assessment results were used to improve the math learning activities by using games to be more complete as a guideline for the next activity.

D. Data Analysis

1. Design and development of math learning activities using games in content analysis

2. Study the results of math learning activities using games:

2.1 Comparison of mathematical achievement before and after mathematical learning activities using games for t-test dependent

2.2 The study of teamwork after organizing mathematical learning activities using games was analyzed for mean (" $\bar{X}$ ") and standard deviation (S.D.), and the mean results were interpreted as follows.

4.50 - 5.00 means the highest level of teamwork.

3.50 - 4.49 means the high level of teamwork.

2.50 - 3.49 means the moderate level of teamwork.

1.50 - 2.49 means the low level of teamwork.

1.00 - 1.49 means the least level of teamwork.

4. Result

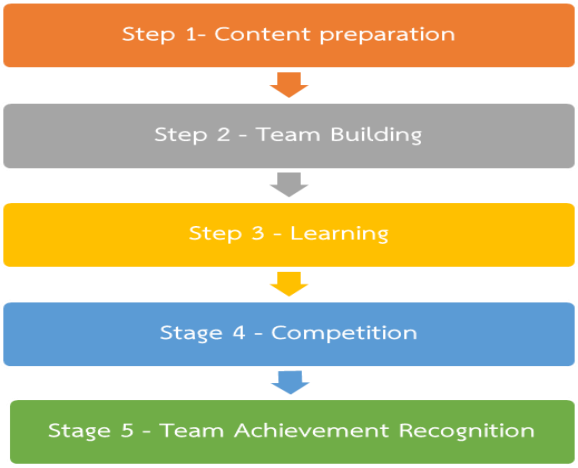
1. The design and development of math learning activities using games had the following results. Mathematics learning activities using games consisted of course description, numbers and algebra, measurement and geometry, and statistics and probability. There were 9 activities as follows:

1.1 Course description of Numbers and Algebra divided into 3 activities: Activity 1- Square puzzle game, Activity 2 - Fraction Puzzle Game and activity 3, Building Collapse Game

1.2 Course description of Measurement and Geometry divided into 3 activities: Activity 1- The Correct Game, Activity 2 - Cross-Section Matching Game and Activity 3- Let's Build Game

1.3 Course description of statistics and probability divided into 3 activities: Activity 1-Snakes and Ladders, Activity 2-Cleanup Time Game and activities 3- Mysterious Egg Game

Math learning activities using games consisted of 5 steps:



2. The study of the results of math learning activities using games found the following results.

2.1 Mathematics achievement of students before and after organizing math learning activities using games as shown in Table I.

Table I showed the mathematics achievement of students before and after math learning activities using games

Math learning achievement	N	$\bar{X}$	S.D.	T	Sig.
Before game-based mathematics learning activities	81	10.93	3.34	19.849	.000
After game-based mathematics learning activities	81	16.85	2.97		

$p < .05$

From Table I, it was found that the mathematics achievement of students after game-based mathematics learning was significantly higher at the .05 level; t = 19.849 and Sig. = .000.

2.2. Teamwork of students after organizing mathematical learning activities using games as shown in Table II

Table II showed the mean and standard deviation of student teamwork after game-based mathematics learning activities

Teamwork	$\bar{X}$	S.D.	Practical level
1. The members of the group can explain the job details clearly and everyone understands.	4.32	0.67	High level
2. I accept the opinions of all members of the group.	4.46	0.59	High level
3. All group members can discuss and exchange ideas.	4.30	0.70	High level
4. I am involved in group work.	4.48	0.69	High level
5. If I don't understand how to work in a group, I will ask a group member.	4.02	0.88	High level
6. I believe that all group members can work towards their goals.	4.49	0.69	High level
7. Group members are free to express their opinions and be able to take action.	4.44	0.69	High level
8. Every member is essential to getting the job done.	4.65	0.48	Highest level
9. All group members willingly accept the results of their work.	4.46	0.67	High level
10. All group members plan to work together.	4.63	0.56	Highest level
Total	4.43	0.69	High level

From Table II, it was found that student teamwork after game-based mathematics learning activities was overall at a high level (" $\bar{X}$ " = 4.43 and S.D. = 0.69). When considered individually, it was found that all members were important to accomplish the task with the highest level mean (" $\bar{X}$ " = 4.65 and S.D. = 0.48), followed by that, all group members were planned for collaboration (" $\bar{X}$ " = 4.63 and S.D. = 0.56) and I believed that all group members could work towards their goals (" $\bar{X}$ " = 4.49 and S.D. = 0.69), respectively

5. Discussion

1. Mathematics learning activities using 9 games in the process of learning activities consists of 5 steps: Step 1- Content Preparation: Preparation of content, games and simple questions which are subject matter questions the students have learned and how to score in games and learning materials, Step 2 - Team Building: Instructors organize teams of different learners for both genders and abilities, Step 3 - Learning: Instructors guide learning methods, planning teams, and competitions to prepare all group members ready to enter the racetrack, Step 4 - Competition: All members or students start the game at the same time and Step 5 – Acceptance of team success: Awarding honorable mention in the management of mathematical learning by using math games as the implementation of games in mathematics teaching and providing opportunities for learners to learn through games along with the competition according to the rules, students are eager to study. Consistent with the concept of [2]. it was said that the use of learning games in teaching mathematics was learner-centered, while allowing the learner to learn by himself through games and able to solve problems from problems within the game. Games contributed to memory and promote better learners' development. [1]. say games were educational innovations. Most teachers agreed that a certain played activity or game could be used to motivate students. Teachers could use the game to teach in order to achieve the goal of teaching because games were activities that provide students with an environment for organized competition with specific objectives and fun activities.

2. The study of the results of math learning activities using games consisted of mathematics achievement and teamwork as follows:

2.1 The students had mathematics achievement after mathematics learning management using games were significantly higher than the .05 which was based on the assumptions made. It was shown that organizing

mathematics learning activities using games is an activity that students had fun and gained knowledge without knowing it. Games were also an important medium that made students more interested in their studies. In line with the research of [5].a series of learning activities were developed using math games on addition, subtraction, multiplication and division for 10th grade students. The research results showed that mathematics achievement using post-study mathematical activity was significantly higher than before study at the .05 level.

2.2 Students had a high level of teamwork after overall game based mathematics learning management. When considered individually, it was found that all members were essential to accomplishing the task with the highest average, followed by all group members planned to work together and I believe that every member of the group can work towards the goal. Therefore, it had been shown that organizing math learning activities using games promotes teamwork, which was an essential part of interpersonal skills and collaboration planning, having a common goal of work and setting goals for the team to work successfully. According to [6]. the game was played in multiplayer or cooperative action to achieve the objectives set by the rules or was agreed upon using media or plays equipment as well as specifies the scoring or method of determining winners and losers. In line with the [4]. said the game was to learn and develop strategies for working with others. Respecting the rules of play was part of building a healthy relationship between the participants. It also promotes adaptability to others and society and fosters good leadership and follower characteristics.

6. Recommendations

A. Recommendations for Practices

Before organizing a math learning activity using games, teachers should establish rules that will allow all learners within the group to participate in the game. In grouping for games, students with high, intermediate and low ability students should be grouped together.

B. Recommendations for Further Research

Development of mathematical learning activities using games for learning management should study at other levels as well.

7. Conclusion

Math learning activities using games. providing opportunities for learners to learn through games along with the competition according to the rules is an activity that had fun and gained knowledge without knowing it. Games were also an important medium that made students more interested in their studies. As a result, students have higher mathematical achievement and promote teamwork

References

1. J.D. Grambs, J.C. Carr, and R.M. Fitch, Modern Methods in Secondary Education. 3rd Edition. New York.: Hoit, Rinehart and Winston, 1970.
2. R.T. Heimer and C.R. Trueblood Strategies for Teaching Children Mathematics. Washington D.C.: Addison – Wesley Publishing Company, 1977.
3. S. Kemmis, & Mc Taggart, R. The action research Planner (3rd ed.). Geelong: Deakin University Press, 1988.
4. K. Suksai. The results of activities in the form of mathematical games on multiplication on mathematics achievement of 9th grade students of Banpot Phisai Kindergarten (Wat Som Siew), Nakhon Sawan Province. Nonthaburi: Sukhothai Thammathirat Open University, 2013.
5. L. Nakaew. Development of learning activities using mathematical games. On addition, subtraction, multiplication and division for 10th grade students. Bangkok: Srinakharinwirot University, 2009.
6. J. Megarry. Simulation and Game in Education. In The International Encyclopedia of Education : Research and Studies, 1985.
7. Ministry of Education. Basic Education Core Program, Year 2008 (Revised version 2017). Bangkok: Printing House of the Agricultural Cooperatives Association of Thailand, 2017.
8. R. Liyavanich. Handbook of mathematics teachers for teaching mathematics using games. Bangkok: Chulalongkorn University Press, 2012.