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A Study of the Effectiveness of Game Based Learning Strategies for Enhancing Achievement and Interest in Mathematics among Middle School Students

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ABSTRACT

This paper presents a quasi-experimental design to study the Effectiveness of Game Based Learning strategies for enhancing Achievement and Interest in Mathematics among the Middle School Students. Two groups were formed, one experimental group and another control group. Pretests of both the groups were taken and then the experimental group was taught using Game based learning strategies and the control group was taught using traditional methods. Post tests were conducted on both the groups and the achievement scores were calculated. Interest inventory was administered on the experimental group to understand the effectiveness of game based learning strategies qualitatively. This study illustrated methods to design and execute Game Based Learning strategies in Mathematics subjects to help students develop holistically.

Keywords: Game based learning strategies, enhancing achievement, interest, Mathematics subject, holistic, learning

INTRODUCTION

Games are structured forms of play, which involve fun, entertainment and learning. Games are played purely for enjoyment, sometimes for achievement or reward as well. Games can be played alone, in teams, or online; by amateurs or by professionals. The players may have an audience of non-players, such as when people are entertained by watching a chess championship. On the other hand, players in a game may constitute their own audience as they take their turn to play. Often, part of the entertainment for children playing a game is deciding who part of their audience is and who is a player. Rules, challenges and interaction form key components of games. Games generally involve mental or physical stimulation, and often both. Many games help develop practical skills, serve as a form of exercise, or otherwise perform an educational, simulation, or psychological role.

The way Technological innovation and Information Communication Technologies has fostered economic development, improved levels of education and training. Similarly game based learning strategy describes an approach to teaching, where students explore relevant aspects of games in a learning context designed by teachers. Game-based learning refers to the borrowing of certain gaming principles and applying them to real-life settings to engage users.

According to Rebecca Teed, game based learning emphasis on following feature

- Challenge students in order to motivate them to learn better.
- Fantasy element that engages players in a learning activity through storyline.
- Encourages them to learn from their mistakes.

Rationale of Study

Mathematics is a fundamental skill in our day to day life. Humans have been applying mathematical skills for over 4000 years. Students often perceive mathematics as a difficult subject. This feeling of finding a subject difficult makes them lose interest in the subject which consequently makes a student give up learning in the same subject. So making a subject interesting will boost up the students confidence to get involved in the process of learning. Teachers instructional technique has been viewed to be one of the key components for the teaching-learning process. It was used as a tool to measure academic gains. Teaching mathematics is a process ,where the teachers assist the learner to develop particular thinking.

Instructional games may aid in the process because it fosters discussions among the players, also each member can solicit from the group the required mathematics concepts needed for the game. Discussing among the group about what happen and reflecting on the effect of the actions that were involved helped students retain the concepts in their mind (Boober 2007)

Statement of the problem

A Study of the Effectiveness of Game Based Learning Strategies for Enhancing Achievement and Interest in Mathematics among the Middle School Students.

Need of the Study

"Games teach productive struggle".

Education today is spreading like wildfire. Almost all sections of society have realized the need for education and are trying to get a decent education. Along with evolving education, the teaching learning techniques have also evolved. Teaching technique plays an important role in students' learning process. In the mathematics class, aside from the teachers, the mathematically inclined students may serve as a guide for the students during the exploratory activities. Also learning resources that best fit to the student's level of maturity such as manipulative and any other material to be used in the game playing may aid to better achievement. Students easily recall the mathematical concepts used in the game. Their actions in the game and some other responses that made them win or lose the game can help them recall the mathematical concepts used in the game. Game-based learning includes lessons which are competitive, interactive, and allow the learner to have fun while gaining knowledge.

Thus the researchers thought to make mathematics interesting and bring positive competition among the students to upgrade their achievement, it is a time for overall efforts to orient and redesign the mathematics education in such a way that it will create a world of problem-solving, allow self-directed exploration, deliver scaffold mastery-based learning, provide data for players to monitor their own progress .

Hence the researchers strongly felt the need of introducing teaching with Game-based learning in mathematics among middle school students to enhance the retention and understanding of the subject matter learnt.

Significance of the Study

- The study will throw light on the power of using Game Based Learning strategies to make the classroom instruction student centric. It will demonstrate the potential of using the strategies of shifting the locus of control from teacher to learner, the teacher and the students will be introduced to the joy of teaching and learning with the help of instructional modules incorporating Game Based Learning strategies that can transform the learning environment into an active interactive and collaborative exercise .
- The study will sensitize the educators to drive their teaching learning module in a way that will develop problem solving skills, receive immediate feedback, encouraging productive struggle and persistence in the face of temporary setbacks.
- The principals will be motivated to encourage the use of Game Based Learning in the teaching learning process.

Aims

- To develop the Instructional Module (using Games) for teaching Mathematics to middle school students.
- To study the effectiveness of Game Based Learning strategies among middle school students.
- To study the achievement of middle school students after integrating Game Based Learning strategies while teaching.

Objectives of the Study

- To prepare an Instructional Module (using Games) for teaching Mathematics to middle school students.
- To develop criterion referenced test (pre - test/ post - test) on commercial Mathematics
- To implement the module on a group of middle school student (Experimental group)
- To compare the scores of the pre-test and post-test to ascertain the achievement among middle school students.
- To compare the performance of the students in the experimental and control group to establish the effectiveness of

the module prepared by the researchers.

Research Questions

R1- What are the challenges faced by researchers while using game based learning as a tool in the classroom?

R2- What is the impact of the Instructional Module on creating interest among middle school students?

Hypotheses

$H0_1$- There is no significant difference in the pre-test scores of the experimental and control group in the achievement test of Mathematics.

$H0_2$- There is no significant difference in the post-test scores of the experimental and control group in the achievement test of Mathematics.

$H0_3$- There is no significant difference in the pre-test and post-test scores of the experimental group in the achievement test of Mathematics.

$H0_4$ - There is no significant difference in the pre-test and post-test scores of the experimental group in the interest test of Mathematics

Operational definitions of the key terms

Game-based learning: This refers to the borrowing of certain gaming principles and applying them to real-life settings to engage users,

Achievement: This represents performance outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments.

Interest: It is a feeling or emotion that causes attention to focus on an object, event, or process.

Middle School Students: It is an educational stage that comprises Classes V to VIII.

Scope of the study

- The present study sought to find out the effectiveness of Game Based Learning strategies among Middle School Students.
- The study demonstrates how Game Based Learning helps in enhancing achievement and interest among Middle School Students.
- The study demonstrates how to use the rules of games and integrate in teaching learning modules.

Delimitations of the Study

- **Geographical delimitations:** The present study is delimited to school in Santacruz.
- **Sample delimitations:** The present study is delimited to 50 students of standard VI of R. N. Podar School
- **Tool delimitations:** The results of the present study are delimited to the results obtained in the conceptual understanding test developed by the researchers.

RESEARCH METHODOLOGY

Research Design of the present study

The present study is a Quasi experimental study following the pre-test post-test non-equivalent-group design. In this there are two groups one is called the control group and another experimental group. First pre-test is given to both groups. Then the treatment is given to the experimental group. This followed by the post test for both groups which attempts to find out

the effectiveness of Game Based Learning Strategies for enhancing achievement and interest in mathematics among the middle school students in the topic of " Percentage, Ratio, Proportion, Profit and Loss: as indicated by the post-test scores of the participants. It can be depicted as follows:

O_1	X	O_2	(O_1 O_3:Pre-Test)
O_3	C	O_4	(O_2 O_4: Post-Test)

The differences of the means of (O_1 O_2: Experimental) and (O_3 O_4: Control) were tested for statistical significance.

Sampling Technique

In the present study, the researchers made use of purposive sampling technique. In order to study the effect of the module on students for "enhancing achievement and interest" based on the topic "Percentage, Ratio, Proportion, Profit and Loss".

Participants

The researchers selected VI standard students of R.N. Podar School studying in the CBSE board. The sample for the study consisted of randomly selected 47 students of standard VI for the Control and Experimental group.

Tools for Data Collection

The researchers prepared the following tools for data collection

A) Criterion referenced test to be used as pre-test/post-test;

B) Instructional module, for instructional intervention;

C) An interest scale to assess the interest of the student to learn by the new method.

Procedure for Data Collection

For Experimental Group

Preplanning	Preparing of the pretest and interest inventory on the selected topic to test the entry behavior of the middle school students
Day 1	Administering the pretest and conducting interest inventory with the students
Day 2	Orientation to the topic ratio and percentage, students were divided in groups, Each group was given 8 brain teasers question, whose answer were written on 8 cones, students in the group were told to throw ring on the cones with correct answers, and then find different basic mathematical concepts based on the times students were able to throw the rings on the correct cone.
Day 3	Teacher becomes Simon and gives 6 instructions to students; they have to write the answers to it. The instruction given has two answers, the teacher tells them to calculate the ratio, percentage and decimals of the instruction.
Day 4	Hoolaloop- Teacher gives students 20 questions with concept of percentage, ratio. Students were divided in teams with 3 members per team and each team was told to select 6 questions which involved different types of concepts. Once they have selected questions, they have to verify their answer with another team and then jump the hoola hoops as many times as the answer obtained.

Day 5	Musical Ball – Formula of profit and loss were derived from students, then class was divided in teams with 3 members in each team. Each member of the team will act as manufacturer, shopkeeper and customer. Music will play and each team will start throwing the balls, once the music stops the team who has the ball has to present his product and the remaining teams have to answer the question.
Day 6	Passing the ball - Students were made to form two lines with legs stretched wide, once the music started, the ball was passed across their legs, when the music stops whoever gets the ball has to solve the answers displayed on the screen related to profit and loss.
Day 7	Administering the post test to test the understanding interest and retention of students learning the topic percentage, ratio, proportion, profit and loss.
Day 8	*Administering the interest inventory to get feedback about new way of learning

For Control Group

Pre planning	Preparing of the pretest on the selected topic to test the entry behaviour of the middle school students
Day 1	Administering the pretest and conducting Interest inventory
Day2 Day 3 Day4 Day 5 Day 6	Introduction Percentage as decimals, fraction, Ratio as decimals, fraction , percentage Proportion Profit in Rupees and percent Loss in Rupees and percent
Day 7	*Administering the posttest to test the understanding interest and retention of students by learning the topic of percentage, ratio, proportion, profit and loss.
Day 8	Conducting Interest Inventory with the students

DATA ANALYSIS

Answering Research Questions

RQ1- What are the challenges faced by researchers while using game based learning as a tool in the classroom ?

Game based learning strategies were used for commercial topics like “Percentage, Ratio, Proportion, Profit and Loss”. Students were engaged in the classroom and even outside the classroom. Emphasis were given on developing of cognitive, affective and psychomotor domain of the students

The researchers also feel that including more game based strategies helps the students be actively involved in the learning phase rather than being a passive learner.

However in the present study, the researchers faced number of challenges in the learning process and has make an attempt to overcome some listed below

* Student wanted to call out their friends when they were divided into groups randomly on the basis of numbers and one

of them also mentioned at the end of process that she did not want to be part of it thinking that it would involve more movement and active involvement

To overcome this challenge the researchers used a pattern to number the students and then form a group.

Handling a strength of 47 students was tedious and even controlling their game was difficult.

However, the researchers overcame this challenge by having a co-teacher involved for the games that were conducted outside the classroom.

RQ2: What is the impact of the Instructional Module on creating interest among middle school students?

The game based learning strategies could contribute in increasing the interest among the middle students, the researchers feels that this could be attributed to the fact that the students enjoyed learning through game based learning, as students are conditioned to the traditional methods of teaching-learning and not relating Maths to real life. But through these strategies, students love learning by being actively involved in their own learning process, Tarun said that "It was quite good! game learning was helping me to understand more"! Similarly Anousha gave her view that " I feel game based learning has improved my thinking and the way to approach a question. I think that game based learning has helped me a lot in learning concepts. I think that other subjects should be taught by game based learning as I feel they are very effective as they are more interesting than pen to paper method" On the parallel lines Aisha conveyed that "I like the game based learning because when we play game and write the paper it feel very interesting" Sonakshi said that "the experience of game based learning is awesome.....it has made me more interested in Maths and...made math more fun than it ever was.....I hope some more unique and fun things happen"

Krishiv shared her experience that "I liked the game based learning strategy as many people were actively participating than they do in class. I personally feel as a better learner. My friends and I participate well in the class but during the game based learning we discovered many more concepts and I even learned how to relate math in real life concepts"

This may definitely go a long way in creating the atmosphere which is more relaxed, informal and comfortable for students. This will give them confidence and also develop desirable interest in the children towards the subjects to be learnt.

Verification of Hypotheses

$H0_1$: There is no significant difference in the pre-test scores of the experimental and control group in the achievement test of Mathematics.

Table 1
Numerical data and level of significance for Computation of't' of the Pre -test of control group and experimental group

Group	N	Df	Mean	SD	Table value		t value	l.o.s
Control group	47	85	9.43	5.41	0.05	0.01	2.38	not significant
Experimental group	47		12.54	7.19	1.99	2.64		

From the table, it could be seen that the obtained value of t is 2.38 which is less than the table value of 2.64 at 0.01 level of significance. Hence, the null hypothesis is accepted.

Interpretation:

There is no significant difference in the pre-test scores of middle school students in the experimental and control groups. This indicates the equivalence of the experimental and control groups on the variable being observed: entry behavior on the topic *"Percentage, Ratio, Proportion, Profit and Loss"*

$H0_2$: There is no significant difference in the post-test scores of the experimental and control group in the achievement test of Mathematics.

Table 2
Numerical data and level of significance for Computation of 't' of the Post -test of control group and experimental group

Group	N	Df	Mean	SD	Table value		t value	Los	$100\omega^2_{estimate}$
Control group	47	92	15.77	3.53	0.05	0.01	2.83	Significant at 0.01 Level	6.93 %
Experimental group	47		19.94	5.65	1.99	2.63			

From the table, it could be seen that the obtained value of t is 2.83 which is greater than the table value of 2.65 at 0.01 level of significance. Hence, the null hypothesis is rejected.

Interpretation:

There is a significant difference in the post-test scores of standard middle school students in experimental and control groups.

$H0_3$: There is no significant difference in the pre-test and post-test scores of the experimental group in the achievement test of Mathematics.

Table 3: Numerical Data and Level of Significance for Computing Difference in Achievement test of Pre-Test and Post-Test of Experimental Group

Test	N	Df	Mean	SD	Table value		t value	l.o.s	$100\omega^2_{estimate}$
Pre-test	47	92	12.54	7.18	0.05 Level	0.0l Level	4.94	Significant at 0.01	19%
Post test	47		19.93	7.31	1.99	2.63			

From the table, it could be seen that the obtained value of t is 4.94 which is more than the table value of 2.63 at 0.01 level of significance. Hence, the null hypothesis is rejected.

Interpretation:
There is a significant difference in the pre-test and post-test achievement score of the experimental group at 0.01 levels.

$H0_4$: There is no significant difference in the pre-test and post-test scores of the experimental group in the interest test of Mathematics.

Table 4: Numerical Data and Level of Significance for Computing Difference in Interest Test of Pre-Test and Post-Test of Experimental Group

Test	N	Df	Mean	SD	Table value		t value	l.o.s	$100\omega^2_{estimate}$
Pre- test	47	92	58.34	9.14	0.05 Level	0.0l level	11.94	Significant at 0.01	60%
Post test	47		81.23	9.42	1.99	2.63			

From the table, it could be seen that the obtained value of t is 11.94 which is greater than the table value of 2.63 at 0.01 level of significance. Hence, the null hypothesis is rejected.

Interpretation:

There is significant difference of pre-test and post-test of interest score of experimental group at 0.01 levels

CONCLUSION

Hence from the "t" value it is clear that the null hypothesis is rejected as there is a significance difference in the pre-test and post-test scores of the degree of observed variance is 6% this difference in the performance can be attributed to the instructional intervention with the help of the instructional module using Game based learning strategies.

Thus it could be concluded that the instructional module enhanced their conceptual clarity and retention on the topic "*Percentage, Ratio, Proportion, Profit and Loss"* to a substantial extent.

DISCUSSION

The effectiveness of instructional module in bringing conceptual clarity, interest and retention may be due to involving students in Game Based Learning resources as an approach to teach Mathematics. It is needless to stress the fact that use of Game Based Learning Strategies has become the need of the day and its recognition is a must for quality education. Teaching of any subject using Game Based Learning Strategies helps the teacher to present any difficult topic in a more understanding way and it also helps the students to acquire a clear understanding of the subject matter. This may be due to the present generation of students who have very less attention span and it requires active interaction and presentation of novel stimuli to capture and sustain attention. Students show more interest in learning when not only the focus is developing the cognitive skills but also involving, affective and psychomotor skills.

Suggestions

The researchers have given a few suggestions to the teacher using Game based learning strategies to achieve conceptual clarity as well as to create a student centric learning environment.

Teachers should prepare programs in such a way that the objective of teaching and learning is achieved along with the integration of the use of Game based learning strategies. Concepts in "Percentage, Ratio, Proportion, Profit and Loss "should be taught through working in co-operative groups using game based strategies in the classroom or out on the terrace, playground.

Teachers should prepare the program according to their students' need and maturity level and guide them to make optimum use of gaming strategies. Most of today's students get fully involved when taught through Game based resources.

Students should be given freedom to question. Discuss and explore.

CONCLUSION

Now it is time to introspect about Mathematics education – its objective, its problem, its job potential, its quality, its course content, course conduct method and its relevance to the present day needs of our country. Economic education is a living discipline and is totally different from others. if we analyze the enrolment during the last two decades in percentage terms,

In this paper, the efforts have been made to re- think re- re-design the Mathematics teaching. Efforts have been made by the researchers to introduce instructional intervention using Game Based Learning in order to create conceptual clarity, interest and retention in Mathematics subjects among middle school students. This intervention has made a substantial impact as is evident from the difference between pre-test and post-test scores of the participants. The fact that "t" value is highly significant and the degree of variance between the pre-test and post-test series indicates that the instructional module has been highly effective in enhancing the quality instruction. Thus the researchers sums up by suggesting that every Mathematics researchers should prepare instructional Mathematics should be taught by giving them a practical base and relating it to real situations.

It is high time for soul searching. For an objective appraisal which will provide the basis for enhancing a new strategy for giving a better deal to Mathematics education in the year to come. Therefore, there is the need for an all-out effort to reorient and re-design Mathematics education in such a way that it will be relevant for today and tomorrow.

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