

Effect of Game Based Formative Assessment on the Learning and Motivation of Students Enrolled in Literacy Schools

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Abstract

In literacy education programs, game-based formative assessment (GBFA) has been shown to be a successful strategy for raising student motivation and learning. The beneficial effects of GBFA on kids' cognitive development have been demonstrated by earlier studies. This research aimed to ascertain how GBFA affected students' literacy learning, an area where low accomplishment levels are commonly reported. The study, which was carried out within the positivist paradigm, used a genuine experimental research design with learning and motivation as the dependent variables and GBFA as the independent variable. The 390 literacy schools in Khushab made up the target population. A pre-test and a post-test were given to pupils to gauge their learning outcomes. A 40-item multiple-choice questionnaire (MCQ) based on the scientific textbook was used as an assessment tool. It was intended to test the cognitive domain by concentrating on the first three levels of Bloom's Taxonomy. T-tests and paired sample t-tests were used to analyze the pre-test and post-test scores after data was gathered to meet the study objectives. The results showed that students' learning and motivation levels were higher when they took part in game-based formative evaluation. To increase students' active participation and improve learning outcomes in literacy classrooms, the study also highlights the significance of implementing interactive teaching practices that are backed by the government. To optimize students' learning outcomes, the findings also offer instructors and legislators useful advice on how game-based formative assessment is applied to NFE environments.

Keywords: *Literacy school education, Game-based formative assessment (GBFA), cognitive ability, Learning, Motivation*

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Introduction

Essential elements of teaching and learning process include planning, execution, and assessment (Cetin, 2018). Decisions on students, educational programs, and curriculum development are made using the data gathered from assessments (Capper, 2013). According to Lorsch (2015), it acts as a cognitive interface that helps teachers comprehend the depth of their students' learning and understanding. UNESCO (2017) asserts that education has a major societal impact by improving people's own skills and advancing a country's general development.

One useful method for determining learning challenges and instructional gaps is formative assessment. It alludes to the practice of assessing students' comprehension while they are studying. This approach uses a range of quick exercises, tests, and questions in addition to routine classroom evaluations to track students' development over time. Students may face difficulties during instruction that impact their comprehension of various subjects. Teachers can detect these learning gaps and the areas that need more attention by using formative assessment.

Formative assessment, which is ongoing throughout the course, improves students' academic performance by utilizing a variety of evaluation techniques that cater to their unique learning requirements (Theal & Franklin, 2010). Formative assessment gives students the chance to enhance their performance and attain higher learning outcomes by closely examining each student's unique efforts and development (Brown, Race & Smith, 2005). Formative assessment improves students' comprehension of the concepts they have learnt, according to numerous research (Lin et al., 2023). A variety of cutting-edge assessment techniques have been introduced in recent years, making formative assessment more effective than it was in the past.

Black and William (1998) assert that traditional evaluation techniques are no longer useful for encouraging significant student involvement, especially in non-formal learning environments that serve students with a range of academic backgrounds and prior knowledge levels. Research indicates that students attending literacy schools face a number of obstacles that hinder their ability to learn, with low motivation being one of the biggest problems. Alternative methods have been created to enhance learning outcomes and promote students' academic development since conventional evaluation procedures are unable to sufficiently address these problems.

One such strategy is game-based formative assessment, which uses gamification components to make learning fun and put students at the centre of the learning process (Gee, 2003).

Because it increases students' motivation and engagement in a range of educational settings, the benefits of using games for formative assessment in the classroom are becoming more and more clear. Despite these benefits, this teaching strategy has not yet gained much traction, and little study has looked at how effective it is as a teaching tool, especially in non-formal learning settings.

Incorporating games and entertainment into classroom instruction improves students' recall of information and makes learning more fun and engaging. In e-learning environments, where it is frequently challenging to assess students' motivation and degree of participation, it is especially crucial to implement a system that fosters learning while encouraging learners to become independent (Chelawat, 2022). Online formative assessment increases students' enthusiasm to study in literacy schools, according to several research (Tsai, 2015). Additionally, it is anticipated that incorporating games into formative assessment will affect students' attitudes toward learning, their behavioral intentions, and their academic performance over the course of the teaching process (Lin, 2023). Using formative assessment, educational games offer an efficient way to evaluate students as they learn new information.

Formative evaluation through games is used as a continuous and cyclical process, in contrast to traditional assessment methods that are often carried out at the conclusion of a learning cycle. This method gives teachers up-to-date information on how well their students are studying. According to earlier research, gamified evaluation methods improve students' motivation and learning (Nehla & Hanaday 2020). Digital gaming-Based Learning (DGBL) is a well-balanced blend of instructional content and gaming aspects, according to Nehla and Hanaday (2020). A recreational or leisure component and an educational component are the two fundamental parts of DGBL (All, Castellar & Van Looy, 2016). Previous studies have also shown that gamified assessment systems enhance students' motivation and learning results after assessment activities (Nehla & Hanaday, 2020).

It is possible to encourage students to finish knowledge exams through gameplay by designing games around well-defined learning objectives. These tests can be educational games or quizzes that give teachers and students instant feedback on the concepts that still need to be learned. Due to the growing influence of technology in contemporary education, Kahoot is a popular online platform. It is possible to improve learning and eventually improve educational outcomes by using game-based technology as a formative assessment tool. It can be used in both synchronous and asynchronous learning settings, such as traditional face-

to-face classroom education and machine-mediated communication (Kalleny, 2020).

Kahoot is a useful tool for conducting live learning sessions in both in-person and virtual classrooms, according to Kalleny (2020), who claims that using the web-based program has yielded positive effects in formative assessment. Kahoot! is a contemporary game-based online platform that evaluates students' opinions of classroom instruction while highlighting their motivation and involvement. It can display top-notch pictures and videos that improve the educational process. Kahoot is well known for its capacity to successfully engage, inspire, and instruct students (Kalleny, 2020). The use of background music during formative assessment exercises is another unique aspect of Kahoot, which supports a program created especially to increase students' motivation, attention, and involvement in class.

Over 20 million pupils in the US have used this app since March 2016. These kinds of applications have greatly enhanced students' comprehension and produced more significant learning opportunities (Cetin, 2018). Because students' focus frequently starts to wane after the first ten minutes of a lesson, teachers must keep students' attention throughout the entire class period. Teachers should actively involve students and make the classroom more entertaining to get their attention back. Teachers can use Kahoot! a free assessment tool, at any time throughout a lesson to boost student participation.

It is also a useful instrument for formative evaluation (Babies, 2020). Teachers can create a quiz, debate, or questionnaire by entering their account and using the Create New Kahoot! option (2017). An essential component of the Kahoot! platform is this capability. Additionally, the teacher's screen instantaneously displays the pupils' scores, making it possible to monitor their performance during class activities. Additionally, Kahoot! offers a wide range of choices for organizing and designing quiz titles (Grier, 2021). By providing their username and a special game PIN or access code, students can access the activity on the platform (Ismail & Mohammad, 2017).

Teachers can alter each question's response time in Kahoot! to suit their own teaching objectives. The technology automatically recognizes the right and wrong answers when the predetermined amount of time has passed and sounds a buzzer. The names of the top five pupils are then immediately shown on the classroom screen (Smith, 2015). Additionally, the platform encourages students to raise their academic performance while fostering an engaging, entertaining, and supportive classroom environment (2020).

The purpose of this study was to compare how students' academic performance is affected by game-based formative evaluation.

In comparison to conventional quiz-based assessment methods, it aims to ascertain whether adding game elements to formative assessment can enhance students' comprehension of the subject matter, boost their interest and engagement in the course, and ultimately result in better academic achievement. The results of this study may offer instructors and instructional designers' useful advice on how to successfully incorporate technology to improve teaching methods, facilitate student learning, and raise educational standards.

Theoretical Framework

The present study is grounded in Mihaly Flow Theory, proposed by Mihaly Csikszentmihalyi in 1970. This theory is regarded as an appropriate and valuable framework for understanding how students engage with game-based learning environments (Chan et al., 2021). Flow refers to a psychological state in which individuals experience deep concentration and complete immersion while performing a task that matches their level of ability, being neither too difficult nor too easy. It is expected that the games used during instruction will place students within an optimal level of challenge, allowing them to remain actively engaged without experiencing boredom or excessive stress. This state of flow enhances the learning process and gradually leads to higher levels of motivation and improved academic performance over time (Admiraal et al., 2011).

Researchers have reported that game-based learning enhances students' learning outcomes and academic performance through behavioral factors, such as the participation willingness, cognitive load, and emotional factors, such as enjoyment. Current research further suggests that flow-related components, including perceived difficulty, perceived autonomy, and immersion experienced during gameplay, may serve as universal predictors of effective game-based learning (Chan et al., 2021). Flow is achieved when learners become fully absorbed in a task that is both challenging and attainable. Educational games are generally designed to keep students within this optimal challenge zone, where they remain sufficiently engaged without feeling overwhelmed or losing interest. As a result, experiencing flow over time can strengthen students' motivation, improve their academic achievement, and make the overall learning process more effective as well as enjoyable.

Statement of the Problem

Due to their circumstances, socioeconomic circumstances, and frequent mobility, millions of students worldwide face barriers that keep them from

receiving a high-quality formal education. The Literacy Schools System offers flexible learning alternatives within the education sector to meet the educational needs of underprivileged and out-of-school children. Nonetheless, sustaining student interest and guaranteeing successful learning continue to be significant obstacles in non-formal education (NFE) systems. Because traditional evaluation techniques frequently don't offer prompt feedback, students become disinterested, which has a detrimental impact on their academic performance and raises the dropout rate. To make learning activities more interesting, game-based formative assessment (GBFA) integrates interactive game elements. Compared to traditional evaluation techniques, GBFA provides fast feedback, boosts motivation, and increases cognitive engagement for students engaged in literacy school education programs. Despite these possible benefits, there is no data on impact of assessment through games on performance of students in literacy schools. Thus, this study uses game-based evaluation techniques to investigate literacy school students' motivation and learning. The study investigated whether GBFA improves students' learning retention, comprehension, and motivation more than traditional assessment techniques. The results of this study will benefit educators and practitioners working in non-formal learning environments and add to the body of knowledge already available on creative approaches to assessment.

Conceptual Framework

Present research focused on two variables (games-based assessment IV and Motivation DV). Following diagram illustrates the conceptual framework:

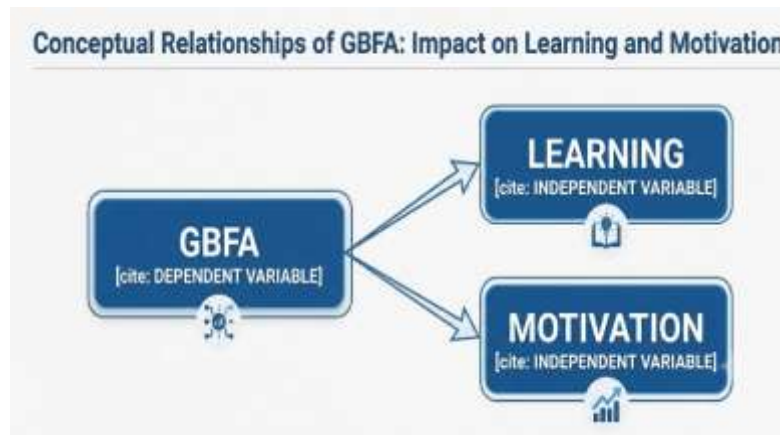


Figure 1: Conceptual Framework

Objectives of the Study

This study aimed to:

1. Find out effect of game based formative assessment on student's learning enrolled in literacy schools.
2. Calculate effect of game based formative assessment on student's motivation level enrolled in literacy schools.

Research Hypotheses

H0¹ Game-based formative assessment has no significant effect on literacy learners' learning.

H0² Game-based formative assessment has no significant effect on literacy learners' motivation.

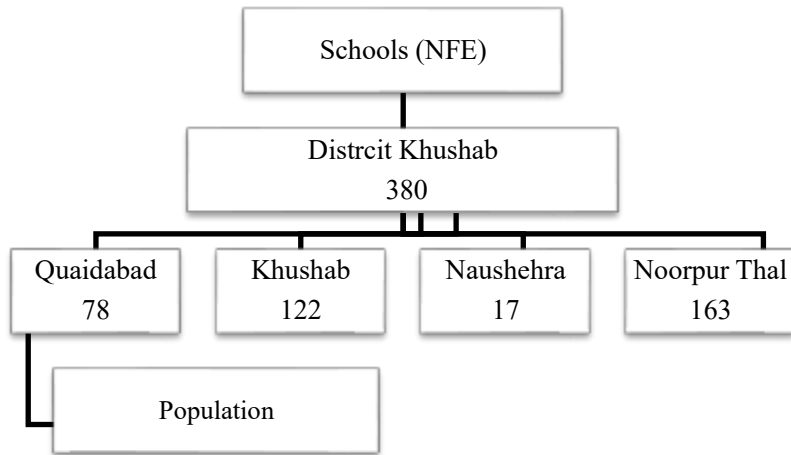
Methodology

Research Design: This study was quantitative and used true experimental research design. Participants were selected randomly. This design enabled the researcher to establish a cause-and-effect relationship between the independent variable (the intervention) and the dependent variable (the outcome). The true experimental design ensured that the tehsils within the district were randomly assigned. Subsequently, one school was randomly selected from each tehsil, after which an intact class was randomly allocated to either the experimental group or the control group. This randomization process helped minimize any pre-existing differences between the groups. Consequently, it strengthened the internal validity of research allowing the researchers to conclude with greater confidence that the observed outcomes resulted from the intervention rather than from other external factors (Shadish, Cook & Campbell, 2002). Description of research design is as follows:

A1	P1	E	P2
A2	P1	C	P2

Experimental Group: (A1), Control Group: (A2), pre-test: (P1), Treatment to Experimental Group: (E), Conventional method: (C), Post-test: (P2)

Population: Participants of this study included 5th graders. The schools from where they were selected from District Khushab.



Sample and Sampling Technique: A sample of 72 students was randomly selected from the target population for this study. Each school was assigned a unique identification number, and one school was randomly chosen through the lottery method. The selection of sample was done after taking participants' informed consent for participation in the study.

The study was conducted among literacy schools located in Tehsil Quaidabad and selected one NFE school randomly. The selected school had two sections of Grade 5. One section was randomly assigned as the experimental group, while the other section served as the control group. The final sample for the study comprised a total of 72 students.

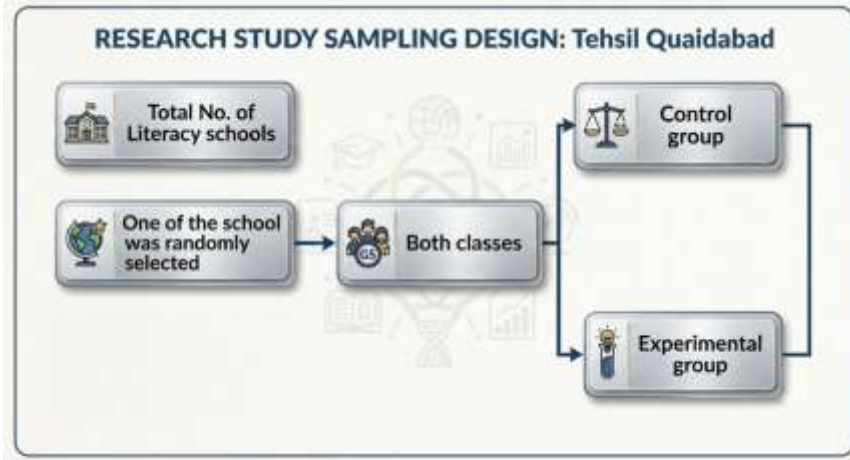


Figure 2: Sample of Study

Instrument: Pre and post-test were used which contained three domains

knowledge, understanding and application. Reliability is important for the trustworthiness and credibility of the study findings as it refers to the consistency of a test score over time. Cronbach's Alpha is one of the most common measures of internal consistency. It measures how well a set of items together measure a single construct. It gives a reliability coefficient that tells the instrument's consistency. In education and social sciences research, a Cronbach's Alpha of 0.70 or higher is generally acceptable and indicates that the instrument has satisfactory reliability.

Table 1
Reliability of the Instrument

Components	N	No. of Items	α	Overall α
Knowledge	36	20	0.724	0.787
Understanding	36	12	0.746	
Application	36	8	0.802	

The above table shows the Cronbach's Alpha $\alpha = 0.78$ which is acceptable (Gliem & Gliem, 2003). For second instrument, the value of Cronbach's alpha was 0.75 for Motivation.

Validity of Instrument: Content validity is when the measured instrument has enough representation of all the aspects included in the concept that is being measured through tests surveys or questionnaires. To show content validity, the instrument must include all parts of the subject matter that are relevant to the construct. Both Instruments were validated by six experts in respective field. The detail of CVI of the instrument and that of the Questionnaire were calculated.

Table 2
S-CVI of Data Collection Tools

Sr No.	Data Collection Tool	No. of Items	S-CVI
1	Instrument	40	0.90
2	Questionnaire	16	0.91

Data Collection Procedure: After Eight weeks, post-test was taken on both groups and data was collected from both groups to apply statistical tests. Formative assessment was conducted on control group through conventional method and experimental group through Kahoot application.
Ethical Considerations: Written permission was taken from literacy department before intervention. The researcher and supervisor together

drew up and signed a formal request letter. The letter clearly stated the research objectives, the aims of the experiment, the methodology employed and the outcomes of the educational process. The research kept all the students' identity confidential.

RESULTS

The research investigated GBFA and NFE students' performance by using Pre-test and Post-test equivalent group design. Data was analysed in Mean and Standard Deviation (SD) of the experimental and control group performances were significantly different based on the findings. The researcher used both forms of t-tests to compare the performance of experimental and control group.

Pre-Test: Comparison of Groups

Table provides the breakdown of the 1st three Cognitive domain that is Knowledge, Understanding and Application of the Experimental and Control group.

Table 3

Pre-test Comparison of Experimental and Control Groups

Sub domain	Groups	n	Mean	S.D	t	df	p
Knowledge	Experimental Group	36	10.29	2.386	-0.87	70	0.39
	Control Group	36	10.80	2.527			
Understanding	Experimental Group	36	5.23	1.987	1.11	70	0.27
	Control Group	36	4.74	1.686			
Application	Experimental Group	36	3.29	1.274	-0.91	70	0.36
	Control Group	36	3.60	1.557			

Table 3 indicates the results of both groups in all the domains of learning. In the "knowledge" sub-domain, the mean score (10.29) of the experimental group is same with mean score (10.80) control group $p=0.39$, indicating both groups are at same level of learning before intervention. There is a slight difference between understanding subdomain of experimental group (5.23) and mean score of control group (5.23) with p -value=0.27 showing that there is no difference between the two groups. The mean score of the experimental group in the application sub-domain

is 3.29 and in control group it is 3.60 with p -value=0.36 indicating no statistical difference and groups are same.

Post-Test: Comparison of Groups

Table 4

Comparison of Groups in Post-test

Sub domain	Groups	n	Mean	S.D	t	df	p
Post Knowledge	Exp	36	15.17	3.785	3.689	70	0.0005
	Group						
	Control	36	12.11	3.094			
Post Understanding	Group				6.062	70	0.0001
	Exp	36	8.86	2.264			
	Group						
Post Application	Control	36	5.69	2.083	5.344	70	0.0001
	Group						
	Exp	36	5.71	1.759			
	Group						
	Control	36	3.34	1.955			
	Group						

Table 4 indicates the results of both groups of post-test in all the domains of learning. In the “knowledge” sub-domain, the mean score of the experimental group (15.17) is higher than mean score of control group (12.11) and p -value=0.0005 indicating both groups are significantly different after treatment. In the “understanding” sub-domain, the mean score of the experimental group (8.86) is higher than mean score of control group (5.69) and p -value=0.0001 showing both groups are significantly different after treatment. In the “application” sub-domain, the mean score of the experimental group (5.71) is higher than mean score of control group (3.34) and p -value=0.0001 indicating that experimental group demonstrates better functioning as compared to control group.

Comparison of Motivation in Control Group

In the following table data has been shown that reflects the pre and post intervention data in control group.

Table 5

Comparison of Motivation in Control Group

Pair	Group	Mean	n	S.D	t	p
Pair 1	Control Pre Motivation	3.17	35	0.58	0.071	0.9437
	Control Post Motivation	3.16	35	0.60		

Table 5 shows the comparison of Motivation in Pre and Post intervention for control group. It can be seen in the table that the value of t for motivation is very low, and the value of p is very high for this construct that shows that there is no significant difference in control group.

Comparison of Motivation in Experimental Group

In the following table data has been shown that reflect the pre and post intervention data in experimental groups.

Table 6

Comparison Motivation in Experimental Group

Pair	Group	Mean	n	S.D	t	p
Pair 2	Pre Motivation	3.20	35	0.48	7.85	< .001
	Post Motivation	4.12	35	0.54		

Table 6 shows the comparison of motivation for experimental group in Pre and Post intervention. It can be seen that value of t is 7.85 for motivation which is very high and the value of p for this construct is less than 0.001. The high value of t and value of p less than 0.001 shows that there is a significant difference in this construct between pre and post intervention.

FINDINGS

1. The findings on knowledge subdomain indicated that before commencement of the experiment, all the participants in both groups were at the same level. The participants participated differently after the treatment in experimental group and scored higher than control group. So, the null hypothesis was rejected.
2. In comprehension and application sub-domains, all the participants in both groups indicated the same level of performance. Difference between experiment and control groups were found after the intervention.
3. There was no significant difference in motivation between pre and post-test in control group. Whereas a significant difference of level of Motivation was found between pre-test and post-test in experimental group. Null hypothesis no. 2 was rejected.

Discussion

The present paper examined the impact of a learning intervention on the learning and motivation of students. The results showed that the learning outcomes in the experimental group were significantly improved

as compared to those of the control group in several cognitive domains due to the intervention of the former. The students in the experimental and control groups started at the same level as indicated by the fact that there was no perceivable difference in the level of their pre-test knowledge. However, the experimental group also had the advantage of a statistically significant difference in the post-intervention results indicating that the intervention was successful in enhancing the acquisition of information by students. These results are in tandem with the results of (Mayer, 2008) who emphasized the importance of structured learning environments in promoting meaningful learning. This was further supported by the pre- and post-test comparison in the experimental group which showed a higher improvement as compared to the control group. This implies that the intervention encouraged more cognitive processing.

The similar trend was observed in the comprehension component. The pre-test data indicated the lack of significant differences between groups that proved the utilization of equal initial levels. Nonetheless, the outcomes of the comparisons of the results of the interventions revealed that the understanding scores of the experimental group were higher than that of the control group. The intervention was also significantly more effective, although the control group was also somewhat improved. This is justified by the Bloom taxonomy which says that one should perform comprehension after having learned some information (Krathwohl, 2002). It also gives the hint that the student might have his understanding scaffolded during an intervention.

There were also strong improvements in the application component, which is used to measure the ability to find solutions. Although both groups performed better on the pre- and post-tests the experimental group performed significantly better than the control group. This implies that the intervention did lead to improvements in the higher-order thinking skills of the students, most likely through the use of either inquiry-based or active learning strategies, which have been shown to produce improvements in the higher-order thinking skills of the students (Hmelo-Silver, Duncan, and Chinn, 2007). Results of this study reinforce the notion that high feedback and practical learning techniques are more effective in forming transferable cognitive capacities (Chi, 2009). The post-test results revealed that the level of involvement in both groups was significantly different with the level of motivation being higher in the experimental group. This indicates that the learning strategy was effective in motivating behavioural and emotional commitment to the learning process besides cognitive commitment. This finding is in line with (Fredricks, Blumenfeld, and Paris 2004), who assert that student interest and the quality of education are two variables that affect motivation which

is a complex construct. Schunk, Pintrich, and Meece (2014) add that academic achievement is a valid measure of motivation, which also contributes to the effectiveness of the intervention.

A significant improvement in Motivation level of the students in experimental group was found between pre and post-test. On the other hand, no improvement was found in pre-test and post-test of control group. There was also a considerable improvement in engagement in the experimental group between pre and post-test. Instead, the control group failed to show improvement on the engagement.

These findings suggest that the intervention positively impacted student engagement that was likely. Delivered by more autonomy, competence, and relatedness, which are important variables in the Self-Determination Theory (Deci and Ryan, 2000). The result that the researcher found interesting was about to immediate feedback that there is significant difference between pre-test and post-test in experimental group whereas there is no significant difference between pre-test and post-test in control group. The control group was always led by the experimental group, and supported the hypothesis that structured, interactive and rich in feedback instructions will prove more efficient than the traditional ones. The implications of the findings are that such interventions can be implemented on a bigger scale.

Conclusions and Recommendations

The study helped to derive the following conclusions:

- A significant difference was found between the mean scores of post-test of all the students of experimental and control groups. Improvement of experimental group is greater than control group. That shows that the cognitive ability of the students of Experimental group improved more than that of Control group students.
- There was an increase in the Motivation level of the students in Experimental Group.

The study recommended that:

1. GBFA may be used to increase cognitive ability so the students as it has improved students' performance in this study. It implies educational situations where games can play a significant role to enhance students' motivation and learning.
2. The teachers may use the assessment in such a manner that may cause improvement in motivation level of the students.

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