

The Application of Blended Learning Model as Way Forward to Improve Learning Achievement in Mathematics

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Abstract: This action research study seeks to determine the effectiveness of Blended Learning Model on student achievement in a mathematics classroom. The research focus is centered on the idea that students learning achievements in mathematics would be enhanced through a new teaching method. The participants involved in this study were a cohort of mixed ability third-grade students. These students were instructed using the Blended Learning Model. The study was carried out for the duration of two months. Mixed methods were applied, including pretests, posttests, and semi-structured interviews. The quantitative data obtained from the achievement tests indicated a rise in overall student learning achievement. Qualitative insights gathered from the semi-structured interviews regarding students' views on the Blended Learning Model revealed a positive perception of this teaching approach in the classroom.

Keywords: Learning achievements, Blended learning model, 3rd Grade, Mathematics education

1. Introduction

Mathematics plays a crucial role in human cognition and reasoning, forming an essential component of efforts to comprehend the world and ourselves. Mathematics offers a useful method for developing mental discipline, promoting logical thinking, and fostering mental sharpness. Furthermore, having a good understanding of mathematics is essential for comprehending the material taught in other school subjects like science, social studies, and even music and art. Researchers worldwide consider mathematics to be a key skill in education. According to Umameh (2011), mathematics education is a crucial and necessary tool for the scientific, technological, and economic progress of any country.

According to Yayuk (2019), the goal of mathematics subjects is to develop the following abilities in learners; (1) Understand mathematical concepts, demonstrate connections between them, and effectively apply algorithms in problem solving, (2) Applying patterns and traits to analyze data and make generalizations by using mathematical manipulations, compiling evidence, and explaining mathematical concepts' (3) Solve problems by understanding, designing, completing, and interpreting mathematical models, (4) Communicate ideas with symbols, tables, diagrams, or other media to clarify problems; (5) Develop a mindset that recognizes the importance of mathematics in everyday life by being curious, attentive, and interested in learning mathematics. Researchers across the world regard mathematics as one of the fundamental subjects in education. Similarly, mathematics had always been featured as a core and compulsory subject in schools of Bhutan (Dukpa, 2015). However, problems kept occurring in mathematics performance at elementary level. National Education Assessment (2021) result states that third grade students of Bumthang's performance in Mathematics did not have any significant improvement while comparing to previous years performance. It also showed that the mean mark of Bumthang district in mathematics with 305 was just above the national meal mark of 300. In contrast, the mean mark of Phuntsholing thromde and Thimphu thromde were 334 and 335 respectively.

Performance in mathematics might have been affected by various factors. However, many educators around the globe blame using inappropriate teaching methods as one of the core factors contributing to poor performance in mathematics. So, it is of paramount importance to look for the teaching methods that suit the current set of learners. Blended Learning Model (BLM) could be an answer to this pertinent issue as it blends traditional teaching methods with technology. The BLM requires traditional learning strategies in face-to-face interactions and other learning strategies using technology to convey material information to students (Gaol & Hutagalung, 2020). So, this paper focused on the implementation of BLM to improve learning outcomes in elementary mathematics. This study aimed to determine the application of the BLM to improve elementary mathematics learning achievement and learners' perception towards the use of BLM.

1.1. The Aim

There is a need for us to devise new approaches that can be used to address issues relating to teaching-learning Mathematics subject. The approaches must be tested, researched, and elucidated to ensure applicability. The aim of this action research is to study the application of BLM in teaching mathematics. The study also examined the perception of students towards the strategies used.

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1.2. Literature Review

Nowadays, technology development attracts teachers' attention to be applied to the learning process from elementary school to the tertiary level. Learning strategies using technology expect to make it easier for teachers and students to achieve an indicator of learning objectives. One learning model at the elementary level that applies technology is the BLM. The BLM is an amalgamation of the benefits of a component of face-to-face and online learning with technology (Rasheed et al., 2020). The BLM combines a conventional and an online learning environment (Yang et al., 2021). Based on these studies, the BLM has the meaning of combining the components of the face-to-face learning environment with the learning components using online-based technology in conveying material information to students.

One of the advantages of BLM is that it uses online media to deliver relevant content to different audiences in different locations. The flexibility to learn on their own is granted to the students. It is possible to effectively communicate to students the purpose of learning indicators, which facilitates their access to the material. Learners become accustomed to using technology (Maulana et al. 2020; (Tanjung et al. 2021). Teachers are encouraged by the BLM to switch from a teacher-centered to a student-centered approach to teaching (Ahmad et al. 2021). In order to best meet the goals of learning indicators, the BLM thus facilitates the delivery of content by teachers and increases students' access to a range of relevant material references through online media.

Lessons in elementary mathematics will benefit from the implementation of this BLM. Mathematics is a science that deals with systematic arrangement of different number symbols and abstract logical reasoning (Sari et al. 2022). Based on this description, mathematics lessons can develop students' logical reasoning using number symbols. Results of research by Rohmawati et al. (2021), which states that the BLM have potentials to increase in elementary mathematics learning outcomes.

In elementary level education, problems often arise in mathematics lessons, including students who do not understand the subject matter. Therefore, in order to help students who struggle with the material covered in mathematics lessons, the author read a number of articles and concluded that the BLM could be an effective way to help them understand the five competencies of Mathematics lessons. Thus, this paper's main focus is on the application of the BLM to enhance elementary mathematics learning outcomes.

This paper seeks answers to those research questions:

- 1) Would there be any improvement in grade three students' learning achievement in mathematics after using Blended Learning Model?
- 2) What were the students' perceptions towards Blended Learning Model in learning mathematics?

2. Methodology

The researcher employed a mixed methodology in this study to investigate the learning achievement and satisfaction of grade three Bhutanese?? students on using the BLM to teach mathematics. This methodology would incorporate both aspects of qualitative and quantitative approaches. The mixed research method, according to Halcomb and Hickman (2015), entails combining qualitative and quantitative data into a single study project. According to Almalki (2016), mixed methodology refers to a kind of research in which researchers combined aspects of qualitative and quantitative research approaches to obtain comprehensive data.

The pretest-posttest was conducted to collect quantitative data to determine students' learning achievement of the sample group before and after the use of BLM. The study also used semi-structured interviews to find out the perception of the students after teaching with the use of BLM.

Finally, the SPSS 22.0 (Statistical Package for Social Sciences 22.0) and MS-excel 2013 was used to interpret the data collected. For a semi-structured interview, the process of coding data was used to analyze and categorize the specific statements into themes.

2.1. Participants

The target population of this study was grade three students studying mathematics in one of the schools in Bhutan. The school is located in Bumthang district which falls in the central part of Bhutan. The research school has only one class of Grade three students for the 2024 Academic Year. The target group comprises 10 Bhutanese students, 6 boys and 4 girls. Therefore, researcher used entire students of grade three as a research participant. The age range of the population are of 9 -14 years old.

2.2. Intervention Plan

2.2.1. One-group Pretest-posttest Research Design

Learning achievement test was conducted before and after the intervention to compare the learning achievement of the students. It consists of pretest and posttest. Pretest was conducted before providing

intervention and posttest was conducted after providing the intervention to the same group of students with the same questions. The intervention was provided for the duration of two months.

The learning achievement test was developed based on the learning outcomes as outlined in the Royal Educational Council (REC) curriculum framework. It was developed as per the guidelines of Bhutan Council for School Examination Assessment (BCSEA). The learning achievement test consists of 5 marks multiple choice questions, 5 marks true or false question and 10 marks short answers type questions.

2.2.2. Semi-structured Interview

A semi-structured interview is one of the highly valuable tool for gaining a comprehensive understanding of a particular phenomenon of interest. The semi-structured interview, according to Lochmiller and Lester (2017), gives researchers greater freedom to conduct interviews in a more conversational style and also makes room for unexpected understanding to surface. Therefore, following the intervention, each student had face-to-face interview with the researcher to determine their perception to the use of the BLM in mathematics instruction. The researcher formulated five questions for the interview. Student were allowed to respond in either English or Dzongkha, the national language of Bhutan, and were given seven to ten minutes to complete their responses. During the interview, each student's responses were recorded on audio. The researcher then subsequently translated and transcribed in English. The data were then analyzed using the thematic analysis technique.

2.3. Ethical Clearance

To minimize the possible risks that the researcher processes may cause a violation of the research code of ethics, the researcher committed to strictly comply with the core standards of ethical practices, confidentiality, and consent throughout the entire duration of the study. The procedures and ethical requirements had been taken into priority. Prior permission was obtained from the school principal and participants' consensus were sought before the commencement of field data collection. Since research participants are below the legal age, the parents of every study participant were obliged to read and comprehend the content of the consent letter before signing it to lessen the violation of the rights of the research participants during the study. Moreover, students were allowed to withdraw from any part of the study should there be an inconvenience.

2.4. Data Analysis

The quantitative findings from the study were analysed using descriptive statistics and a paired sample parametric t-test was conducted to determine the significance of findings. The data obtained from semi-structured interviews was analyzed through content analysis.

3. Results

3.1. Quantitative Results

The data collected from the pretest and posttest scores were analyzed to compare the learning achievements of the Grade 3 students before and after the intervention as described in Table 1.

Table 1. Comparison between pretest and posttest within the sample group.

Group	Pretest		Posttest		Mean Difference	p – value
	Mean	SD	Mean	SD		
Sample Group	12.3	2.71	17.7	2.51	17.7 – 12.3 = 5.4	.000

Table 1 represents the descriptive statistical analysis results for the sample group's achievement test scores. The mean score for the pretest and the posttest were 12.3 and 17.7 respectively. It is evident from the results presented in Table 1.1 that the posttest mean score ($M = 17.7$) of the group was higher than that of the pretest mean score ($M = 12.3$) with a mean difference of 5.4. The greater mean score in the posttest indicated the efficiency and effectiveness of using BLM.

The green line and the red line in Figure 2 represent the individual student's learning achievement scores in the pretest and posttest respectively. All the students have performed better in the posttest than in the pretest as shown in the line graph. The change between the achievement before and after using BLM is therefore visible.

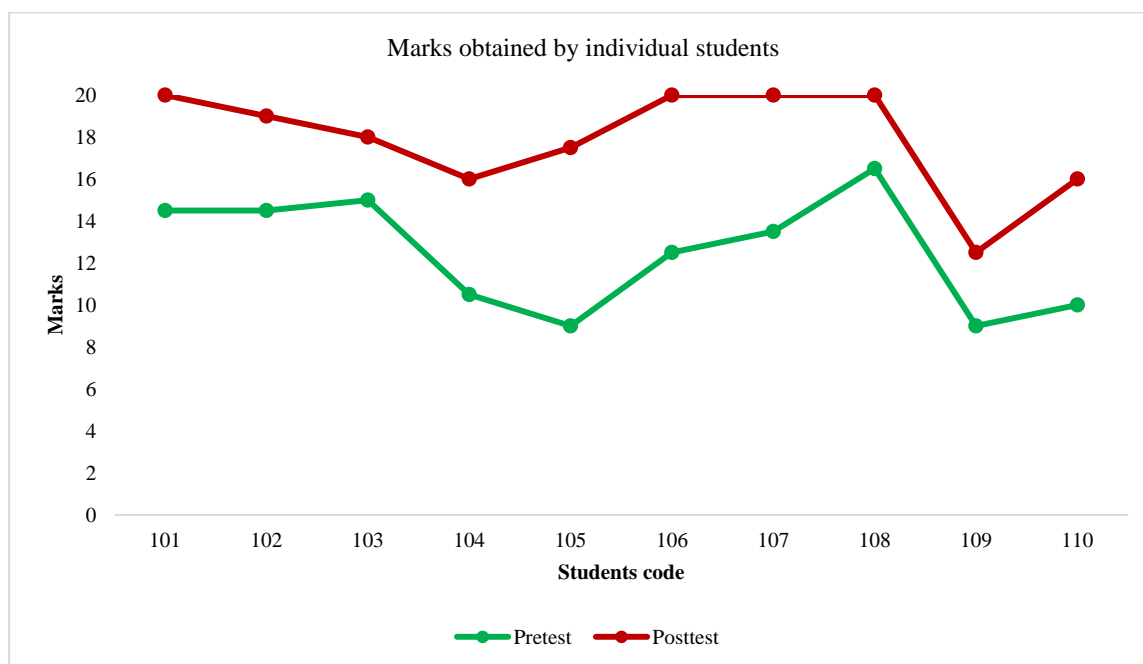


Figure 2. Comparative graphical representation of individual student learning achievement scores in Pretest – Posttest

The lowest and the highest scores in the pretest were 9 and 16.6 respectively whereas the lowest and the highest scores in the posttest were 12.5 and 20 respectively. All the students scored significantly higher in the posttest than in the pretest showing a remarkable improvement in students' achievement in mathematics after using BLM.

3.2. Qualitative Results

The qualitative data was collected through semi-structured interview to further respond to the second objective of the study. The second objective of the study was to find out whether teaching mathematics using BLM would increase students' learning satisfaction or not. The interview was conducted at the end of the intervention with all the students of the sample group. To protect the privacy of the research participants, the researcher has used the same student code which was used during pretest and posttest during the time to interview. The students were allowed to speak in the language they felt comfortable to share their opinions on the study. The response of students was recorded and transcribed in English for data analysis. The data were then analyzed using the thematic analysis technique.

The data were read, analyzed, and coded (interpreted) into themes based on the research objectives and questions of the study. The data from the students' interviews are analyzed under three themes: 1) Interesting and Fun, 2) Facilitated Learning Satisfaction, and 3) Revolution in Learning.

3.2.1. Interesting and Fun

When BLM was integrated into teaching mathematics, most of the students were very much thrilled to learn mathematics. The data collected through the Students' Group Interview showed that the use of multimedia in the mathematics classroom attracted the participants' interest and made learning joyful. The lesson was found fun with amazing motion and lights. Contents of the media (videos) like dialogues, rich vocabulary, good pronunciation, and involvement of audio-visual senses attracted the participants' attention in learning.

"The use of PPT and video have made the lesson more interesting and fun to learn. I enjoyed the lesson very much and we understood better"

"It was fun to watch videos in the class because I could understand better and get extra knowledge. In the video I can see real but in the normal lesson I just hear".

"I enjoyed the lesson because it was interesting and fun learning. I understood the concept better and in an easy way".

3.2.2. Facilitated learning satisfaction

The opinions and learning experiences shared by the participants during the interview session revealed the positive learning satisfaction of using BLM in teaching and learning mathematics. Most of them shared learning mathematics through BLM gave them the opportunity to understand better.

“When I study through video clips and PPT, we understand very easily. The examples from the video clips made me understand the concept that I couldn’t during normal teaching”.

“Learning through BLM made me understand better because it provides the use of multimedia in teaching-learning. I could understand more about the topic. I could answer almost all the question in the test after learning through multimedia”

3.2.3. Revolution in Learning

All the students during the interview mentioned that BLM is different from other methods because it provides them an opportunity to learn in two ways (normal teaching and use of multimedia). Most of the interviewee responded that using multimedia for teaching and learning mathematics was a new thing for them and it has a positive impact on their learning.

“Usually we learn mathematics with the help of chalk and chalkboard, chart paper, text, manipulative and sometimes going outside or through the use of multimedia. But BLM is new for me because it uses two methods at the same time. It helped me to learn the concept better and in an easy way. It's fun and saves boredom.

“Till now most of the time we were taught mathematics using one method. The use of BLM made me learn mathematics with fun. The difficult topics were made easy to understand because the mixture of normal teaching blended with multimedia made us understand better and in an easy way.

Without much dislike to the use of BLM, it can be understood that children loved learning mathematics through the use of BLM. With the responses from the children to the interview question, it is very clear that learning mathematics using BLM has really boosted their interest in learning.

4. Discussion, Conclusion and Recommendations

The study disclosed two major findings. The first finding of this study was the use of BLM had improved learning achievement of grade three students. This was evident with the results compiled from the learning achievement test which displayed the increase in mean score by 5.4 of the sample group in posttest while comparing with pretest (table 1.1). All the students have performed better after the use of intervention as shown in figure 1.1. This is in line with the study carried out by Rohmawati et al. (2021), which states that the Blended Learning model have potentials to increase in elementary mathematics learning outcomes. The improved learning achievement can be attributed to the shift in teaching methods from teacher-centered to students centered. This is parallel to the study carried out by Ahmad et al. (2021). Their finding states that teachers are encouraged by the BLM to switch from a teacher-centered to a student-centered approach to teaching so as to enhance learning achievement.

The second major finding of the study was that learners had positive perception towards the use of BLM to improve the learning achievements of grade three students. The data were collected through a semi-structured interview which was conducted at the end of the experiment. These findings revealed that learners were highly positive towards the use of BLM. Almost all the learners enjoyed learning with the use of BLM throughout the learning session as it blends traditional methods with technology. This finding is parallel to the research finding Yang et al. (2021). Their finding states that the BLM combines a conventional and an online learning environment. Learners learnt with fun, curiosity which made the classroom safe and conducive for learners. It was also in line with the studies conducted by Rasheed et al. (2020) which states that the BLM is an amalgamation of the benefits of a component of face-to-face and online learning with technology.

This study aimed to evaluate the effectiveness of using BLM in teaching mathematics to Grade Three students. The findings revealed that the use of BLM improved learners’ achievement and that learners demonstrated positive perceptions toward this approach in enhancing mathematics learning outcomes. Therefore, based on the results of the study, several recommendations were made, which may be valuable and beneficial for improving the teaching and learning of Mathematics.

In terms of practice, teaching through BLM had a positive impact on learners’ learning achievement. The results of the study showed that posttest performance was significantly higher than pretest performance. Thus, the integration of BLM into daily classroom instruction is highly recommended. In addition, teachers may consider applying BLM in teaching other subjects in order to make lessons more interesting and engaging, which may further enhance learners’ achievement.

With regard to future research, further studies may be conducted to examine the effectiveness of BLM in other subject areas and across different levels of education. Moreover, additional research may investigate the influence of variables such as gender, age, level of study, and mode of study on the implementation of the BLM approach in various learning contexts, thereby expanding knowledge about students' learning outcomes and academic achievement.

5. Limitations

This study was limited to one section of Grade Three students from a primary school in Bumthang District, Bhutan. Therefore, the findings of the study cannot be generalized to the performance of all Grade Three students across Bhutan. In addition, the study was confined to examining the use of BLM in improving Grade Three mathematics achievement. As a result, the findings do not reflect learners' performance across the entire mathematics curriculum.

6. Conclusions

In conclusion, if the schools implement the use of BLM, the learners will obtain better achievement in the tests. The use of BLM contributes to active learning and better understanding. The application of the BLM can stimulate student engagement in their learning journey due to the combination of traditional teaching methods and technology-driven online learning. This facilitates a better grasp of Mathematics concepts for elementary school students. Therefore, it has been demonstrated that the use of the BLM in Mathematics classes can enhance the academic performance of elementary school students. It is suggested that researchers delve deeper into this topic by exploring additional literature from various online sources to comprehensively examine the application of the BLM for both students and teachers concerning learning outcomes in elementary school mathematics.

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Ethics Declaration: All participants into the current study were given a consent form and asked to opt in whether they wanted to participate. No additional ethical approval was required to conduct the study.

Data Availability: The corresponding author has access to the data supporting the findings of this study upon request.

Conflict of Interest: The author affirms that there were no conflicts of interest associated with the study.

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