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THE APPLICATION OF MULTIMEDIA TECHNOLOGY IN TEACHING AND LEARNING MATHEMATICS OF GRADE 5 BHUTANESE STUDENTS

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ABSTRACT

The learning objectives of this study were to find out students' learning achievement and satisfaction towards the use of multimedia technology (video clip and PPT) in teaching and learning mathematics in grade 5 Bhutanese classroom. A mixture of quantitative and qualitative methods was employed to gather the required data. The instruments used to gather the quantitative and qualitative data were achievement tests (pretest and posttest) and semi-structured interview respectively. The quantitative data were analyzed using Paired Sample t-test in the computer program and qualitative data were analyzed using the thematic analysis technique. The analysis of the pretest and posttest scores through Paired Sample t-test revealed a higher mean score in the posttest (14.72) than the pretest (8.81) with a mean difference of 5.91. The significance (p) value was 0.001 which indicated that the use of multimedia technology was effective in teaching and learning mathematics. Likewise, the data collected through the semi-structured interview responses revealed positive satisfaction. This study recommends that teachers may also try teaching other topics in mathematics and other subjects using multimedia technology to make their lessons interesting and engaging, thereby enhancing students' performance.

Keywords: Multimedia Technology, Learning Achievement, Learning Satisfaction, Video Clips

Introduction

Modern education made its way into Bhutan in the 60s making the country one of the youngest in modern education with mathematics as one of the core subjects among others. Dukpa (2015) states "Mathematics had always been featured as a core and compulsory subject in the schools of Bhutan". Considering the significance of mathematics in our daily lives, and despite making it one of the major subjects in schools, students perform poorly in the subject. A study carried out by Bhutan Board of Examination (BBE, 2008), revealed that Bhutanese students performed poorly in mathematics.

According to BCSEA (2019), grade 3's overall mean score of mathematics for two years (2017 & 2018) was the lowest with 60.26 while comparing to 64.69 in English and 73.66 in Dzongkha, the national language. Similarly, BCSEA (2019) states that grade 6's overall mean score of mathematics for two years (2017 & 2018) was the lowest with just 39.3 while comparing to 50.6 in English, 55.15 in Social Studies, 56.7 in Dzongkha, and 57.4 in Science. Performance in mathematics might have been affected by various factors. However, many educators blame using inappropriate use of teaching methods as one of the core factors contributing to poor performance in mathematics. According to Royal Education Council (REC, 2012), the reason for low scores in mathematics was mainly due to the fear of mathematics and the traditional teaching method (chalk-and-talk and memorizing out of context). Traditionally, the teaching of mathematics was deduced to teachers' explaining the whole concept and methodology of solving mere numerical problems. According to Peldon (2018), the traditional teaching approach demands the students to memorize the entire text which limits their understanding and thinking skills. There was limited importance given to the understanding of mathematical language, limited connection to a real-life situation, and the limited scope for children to explore different approaches and methodology to problem-solving.

Therefore, it is important to lay a strong foundation of the subject in the early years of learning by using strategies that would enhance students' learning and interest. Thus, adopting a new instructional design suitable for the current era that will enhance the learning of mathematics is of paramount importance. Witzel & Riccomini (2007) state that mathematics teachers and instructional leaders are under tremendous pressure to increase the academic achievements of all students. One of the strategies gaining momentum in

the post-twenty-first century to enhance students' enthusiasm and participation in learning mathematics could be the use of multimedia technology in the classrooms for teaching mathematics.

According to Mayer (2009), in the Cognitive Theory of Multimedia Learning (CTML), a presentation or representation that combines words with visual material may be used to define multimedia. Multimedia technology does not only mean modern gadgets like using Hi-Tech digital equipment, it also means simple things like short video clips, text, PPT, graphics, and many more. In this research, the term multimedia technology means the use of PowerPoint presentation (PPT) and short videos for teaching-learning mathematics (fractions). Though the use of PPT and short video clips are obsolete in many of the digitally sound countries around the globe yet not for a country like Bhutan who is still young in the world of technology. Even today, the tools like projectors and computers are merely used in higher grades but not in primary schools. According to Subba (2011), some of the multimedia technology tools used in the Bhutanese classroom are the tape recorder, computers, projectors, CD ROMs, and OHP.

Consequently, the researcher decided to examine the effectiveness of multimedia technology in teaching and learning mathematics concerning students' learning achievement and satisfaction. So, the findings from this study will provide teachers with an alternative effective strategy to enhance students' learning achievement and satisfaction in the subject.

Research Objectives

1. To improve the learning achievement of grade 5 Bhutanese students in mathematics (fractions) after using multimedia technology.

2. To find out grade 5 Bhutanese students' learning satisfaction in learning mathematics (fractions) after using multimedia technology.

Literature Review

1. Mathematics Curriculum in Bhutan

Since Bhutan did not have its own curriculum, it was borrowed from India**.** Later a strong need was felt to develop its own curriculum that aligned with the national policies and that catered to the needs of the Bhutanese learners**.** Hence, the Ministry of Education, Bhutan, initiated a major mathematics curriculum reform for all grades pre-primary till 12 with the aim to enhance mathematic education in the country **(**Policy Planning

Division, 2006). So, the new mathematics curriculum was developed, organized, and planned integrating only the appropriate and necessary topics as per the Bhutanese context. It meets the current international trends and demands to go with the flow of the situation.

2. Concept of Mathematics

Famous mathematicians, philosophers, and recognized organizations have defined mathematics in different ways. Clapham and Nicholson (2009) state that "mathematics is the branch of human inquiry involving the study of numbers, quantities, data, shape and space and their relationships, especially their generalization and abstraction and their application to situations in the real world" (p.505).

Similarly (Hom, 2013) states that mathematics is the science that deals with the study of relation and order of counting, structure, measuring with logical reasoning which everybody uses in the form of building blocks, devices, sports, arts, money, and space. In simple words, mathematics is the science that deals with the arrangement, quantity, and logic of shape. The importance of mathematics is parallel to the development of technology as mathematics is what actually computer does. Hence, it is important to have a mathematics curriculum as a core subject in any educational institute in the world.

3. Multimedia Technology

The word multimedia is entirely used to describe multiple forms of media. The capability to communicate in more than one way is called multimedia (Shaikh 2011). Multimedia devices can be any electronic media device that is used for storing and experiencing multimedia content. It can be recorded and accessed by any information content processing devices, like computers and electronic devices. According to Pavithra (2018), multimedia is the field concerned with the computer-controlled integration of text, graphics, drawings, still and moving images (Video), animation, audio, and any other media where every type of information can be signified, stored, communicated and handled digitally.

- **Instructional multimedia technology**

Today, technology has drawn considerable attention from the educational community around the globe because of its potential to support teaching and learning in the course of last two decades. According to Fu (2013, p12), instructional technology includes electronic delivery systems widely used in today's education field such as computer, radio, internet, television, and projector among many others.

Being in the post 21st century era, the need for change in style and approach in teaching and learning with the use of instructional multimedia technology is felt globally. Fu (2013) states that using educational technology allows students to collaborate at any time by sharing information. Therefore, instructional multimedia technology provides an array of options and learning solutions.

- **Multimedia technology and teaching mathematics**

Multimedia technologies are probably one of the most exciting innovations in the information age. The rapid growth of multimedia technologies over the last decade has brought fundamental changes to learning mathematics, in particular and educational system as a whole. It creates a suitable learning context that enables a learner to control the learning environment.

These views were supported by researchers in the field of mathematics education who agree that multimedia technology can have greater positive effects on students' learning when applied in student-guided instruction as opposed to teacher-directed instruction (Hong & Koh, 2002). Similarly, Yu, Lai, Tsai, & Chang (2010) states that teachers' teaching ability and students' learning achievement in the classroom environment can be enhanced by using multimedia technology in the classroom.

- **Multimedia selecting criteria**

Before putting the multimedia (PPT and videos) into practice, it is crucial for teachers to choose appropriate media in order to have a significant impact on teaching and learning. Some of the standards that need to be considered while selecting multimedia are:

Content: The material that the teacher chooses should be in line with the learning standards of the curriculum. It is important to study the contents of the media before taking it to the classroom for teaching and learning process. As stated by (Stephens et al. 2012) the media that we use should be enticing and motivating for the students to watch and simultaneously be rich in content. **Students' Age and Interest:** Any media chosen must be appealing to the students and must motivate the students to learn. This was supported by (Lopez, 2016) who states that the right choice must be made depending on students' likes and age. Appropriate media will enhance the students' interest and foster their learning.

Clarity of Message/Language: The language ability level of the students and the clarity of the media needs to be considered while choosing any media

Pacing: The pace of the language used in the media must be appropriate to the students' level. If it is too fast students will not catch up anything and if it is too slow it will bore the students.

Graphics: Visual aspects in media are vital as the picture supports the understanding and serves the purpose of scaffolding. According to Yunianti (2014), graphic is visual tools that support and enable students to see the relationship between facts, terms, and ideas.

Length of the media: The length of any media that we use should be age-appropriate so as to have a maximum attention level. For example, the length of the media should be between 4 to 6 minutes (for age 10 to 12 years old) to have the maximum understanding of the contents of media in the class.

- **Framework for application of multimedia in the classroom**

To draw the maximum advantages from multimedia used in the teaching and learning processes, the facilitator must follow the correct procedures. The correct procedures needed to be followed by the facilitator are:

Pre-Use: Before starting the use of multimedia (PPT and Short video clips), a teacher must choose media by following all the criteria mentioned above. After that, teachers should make students aware of the learning objectives and clearly instruct what they should be doing after watching the media (videos) or going through what was on the PPT.

During Actual Lesson: While using the media (videos & PPT), the teacher should remain in the classroom with the learners to facilitate and support them. Also, teachers should be vigilant during the time of using media and make sure everyone is moving with the media in use.

Post-Use: A follow-up activity is one of the crucial amongst all the activities if we want to fulfill our learning objectives. Hence, follow-up activities like a discussion of events, reviewing, retelling, clarification of complex points, and completing of the exercises must be carried out in this stage.

Conceptual Framework of the Study

In this study, there are two variables; independent variable and dependent variable. Multimedia technology (video clip and PPT) was the independent variable whereas students' learning achievement and students' satisfaction with the use of multimedia technology to learn mathematics were the dependent variables.

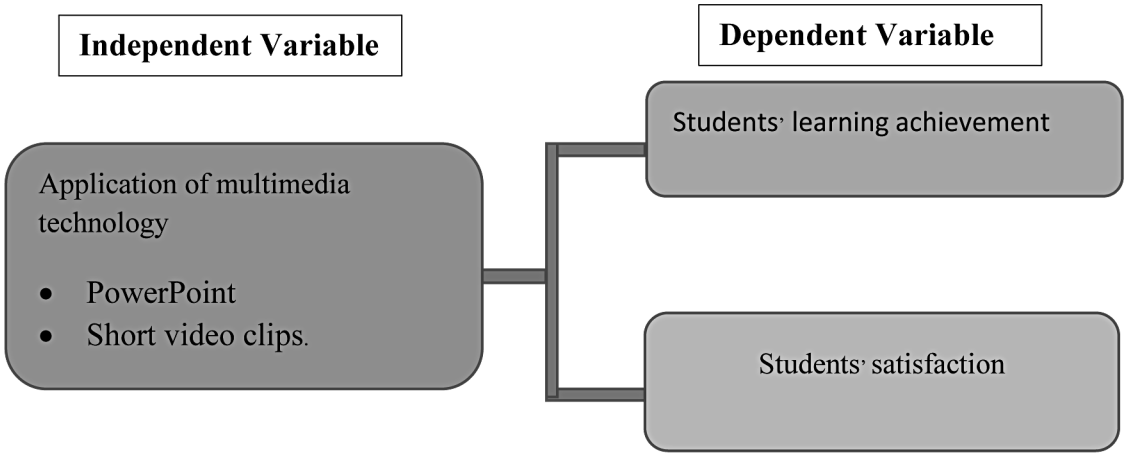

Figure 1 Independent Variable and Dependent Variables

Research Methodology

1. Research Instruments

Almalki (2016) describes mixed methodology as a type of research where elements of both qualitative and quantitative research approaches are combined to gather in-depth information by researchers. Hence, the researcher applied a mixed method to carry the study. The pretest and posttest were used to collect quantitative data to determine the participants' learning achievements before and after the use of multimedia technology.

The study also used semi-structured interviews to find out the satisfaction of the students after teaching using multimedia technology in mathematics. Figure 2 below describes the research design of the study

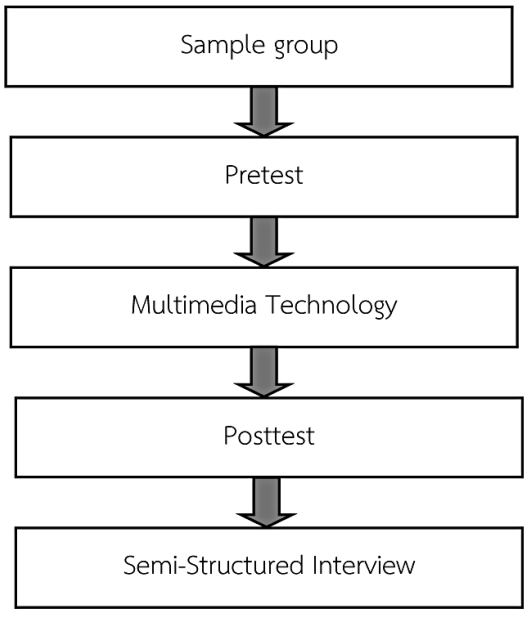

Figure 2 Illustration of Research Design

1.1 Lesson Plans

The researcher designed four lesson plans of 90 minutes (1 lesson plan = 2 sessions) each, to teach mathematics to grade 5 Bhutanese students on the topic "Fractions". The topic was further divided into 4 sub-topics and was taught over four weeks. With two sessions every week, a total of 8 sessions were conducted. All the lessons were planned incorporating multimedia (PPT & video clips) for teaching the research participants.

1.2 Achievement Tests

A learning achievement test was conducted before and after the intervention to compare the learning achievement of the students. Pretest was conducted before providing the intervention and posttest was conducted after providing the intervention to the same group of students with the same questions. The learning achievement test was developed based on the learning outcomes outlined by the Royal Educational Council's (REC) curriculum framework, and as per Bhutan Council for School Examination Assessment (BCSEA) guidelines. Learning achievement test consisted of 5 marks multiple-choice questions, 5 marks true or false question and 10 marks short answer type questions

1.3 Semi-structured Interview

To explore students' satisfaction towards the use of multimedia in learning mathematics, in groups of three

members each, a face-to-face interview was conducted after the intervention. The interview consisted of 5 questions that the researcher has framed. Each group took approximately 7-10 minutes to respond and was given the freedom to answer either in English or *Dzongkha* (national language of Bhutan). The responses of each group were audio recorded during the interview and later the researcher translated and transcribed into English. The data were then analyzed using a thematic analysis.

1.4 Validity

The validity of research instruments were validated by 3 experts, a professor from Rangsit University, Thailand, and two experienced mathematics teachers from Bhutan. The Item Objective Congruence Index (IOC) was calculated by using the statistical formula. All the instruments for this study were validated and rated above 0.67 by the experts which indicated that the items were valid for the study. The IOC for lesson plans and learning achievement test questions were rated +1. The semi-structured questions were rated 0.934 which was above 0.67.

1.5 Reliability

To check the reliability of the achievement test, the researcher conducted a pilot test consisting of 5 marks multiple-choice questions, 5 marks true or false question, and 10 marks short answer questions with another section (34 students) of grade 6 students in the same school. Kuder- Richardson formula (KR-20) was applied to check the reliability coefficient of the learning outcome test. The KR-20 coefficient obtained was 0.731 which was greater than 0.70. Thus, the coefficient of 0.731 revealed that the test items were reliable.

1.6 Participants

The target population of this study was grade 5 students studying mathematics in one of the schools in Bhutan. The school is located in Bumthang district which falls under the central part of Bhutan. The age range of the population was 11-13 years old. The research school had only one section of grade 5 students for the 2021 academic year. Therefore, the researcher used entire students of grade 5 as research participants. The sample/research participants comprised 32 mixed genders and abilities grade 5 Bhutanese students for the study.

2. Data Collection Procedures

2.1 Approval and Ethics Concern

The researcher sought approval from the research and development institute, Rangsit University. Then the researcher obtained an approval letter

from the Ministry of Education in Bhutan, Chief District Education Officer (CDEO), Principal, and concerned subject teacher of the research school before the actual data collection began.

Since research participants were below the legal age, the parent of every study participant was obliged to read and comprehend the content of the consent letter before signing it to lessen the violation of rights of the research participants during the study. The participants' details, opinions, and interview records were kept confidential throughout the study.

2.2 Data Analysis

2.2.1 Test Scores Results

Learning achievement scores from pretest and posttest were analyzed using paired samples T-Test by using a suitable computer software program. The comparison was carried out based on mean, standard deviation, and significant value. The value of 2-tailed significance value (p); in other words, P≤.05 level of significance was referred to determine the significant difference between the means.

2.2.2 Analysis of Test Score Results

The result revealed that all the students scored significantly higher in the posttest than in the pretest showing a remarkable improvement in students' achievement in mathematics after using multimedia technology. The mean score for the pretest and the posttest were 8.81 and 14.72 respectively. It was evident from the results presented in the table below that the posttest mean score ($\overline{X}$ = 14.72) of the group was higher than that of the pretest mean score ($\overline{X}$ = 8.81) with a mean difference of 5.91. The greater mean score in the posttest indicated the efficacy of using multimedia technology. A paired sample t-test in the table also displayed a significant value of 0.001 which indicated the significance of the test. The standard deviation of the pretest and posttest were 3.23 and 2.43 respectively.

The lowest and the highest scores in the pretest were 2 and 15.5 respectively whereas the lowest and the highest scores in the posttest were 9.5 and 19 respectively. The highest score difference between pretest and posttest was 13.5 scored by two students and the lowest was 1.5 scored by one student. All the students scored significantly higher in the posttest than in the pretest showing a remarkable improvement in students' achievement in mathematics after using multimedia technology.

2.2.3 Semi-Structured Interview

A semi-structured interview was conducted to acquire a deeper perspective and clearer understanding of the students' satisfaction towards using multimedia technology in learning mathematics. The data gathered through a Semi-structured interview was analyzed after developing themes and patterns through coding using thematic analysis.

2.2.4 Analysis of Semi-Structure Results

The core data collected from semi-structured interviews were analyzed under five themes: 1) Interesting and Fun, 2) Desire to Learn, 3) Facilitated Learning Satisfaction, 4) Learning Motivation, and 5) Revolution in Learning. Most students gave a positive response to using multimedia technology in learning mathematics.

Interesting and Fun: When multimedia technology (video & PPT) was integrated into teaching mathematics, most of the students were thrilled to learn mathematics. The data collected through the Students' Group Interview showed that the use of multimedia in the mathematics classroom sustained participants' interest and made learning joyful.

"We felt happy and excited to learn using PPT and video clips because it was interesting and fun. We could understand easily and we wish to learn other topics too with the help of PPT and video clips"

Desire to Learn: Using multimedia technology in teaching and learning mathematics helped them not just in understanding the concept, but also in retaining the information learned. Therefore, using multimedia technology in teaching sustained their interest and desire to learn mathematics.

"We would prefer to learn other topics too using PPT and Video because it is with fun, activities are very interesting and it helped us to understand the concept easily"

Facilitated learning satisfaction: The opinions and learning experiences shared by the participants during the interview session revealed positive learning satisfaction of using multimedia technology in teaching and learning mathematics. The contents of the media like dialogues, rich vocabulary, good pronunciation, and involvement of audio-visual aspects attracted the participants' attention in learning.

" Multimedia technology helped us to learn mathematics better because we could understand the content better in an easy way. We could answer most of the question without any problem"

Learning Motivation: Most students during the interview mentioned that they were highly motivated to learn when multimedia was used in learning mathematics. The use of multimedia made learning easier, which encouraged and inspired them to learn and take part in classroom activities. Thus, the students were very much excited.

"We had a great time learning mathematics through multimedia. Through this media, we have gained more knowledge. Now we will watch more videos related to mathematics because we get much more new knowledge".

Revolution in Learning: All the students during the interview mentioned that although they watch videos at home, they said PPT and videos were not used for teaching and learning. Nearly 100% of the interviewees responded that using multimedia for teaching and learning mathematics was new for them and it made a positive impact on their learning. Most of the respondents answered that they were usually taught mathematics using chalk and chalkboard, manipulative, text, and sometimes going outside the classroom to carry out some activities on measurement.

"Usually we learn mathematics with the help of chalk and chalkboard, chart paper, text, manipulative and sometimes going outside. It is new for us to learn mathematics using PPT and Video clips. It helped us to learn the concept better and in an easy way. It's fun and saves boredom. We would love if other topics too were taught using PPT and Video clips"

Discussion and Conclusion

The following discussion intends to present the findings in detail according to research objectives.

1. Learning Achievement

The results of the study showed that the use of multimedia technology was effective in teaching and learning mathematics. The findings revealed that the posttest mean scores ($\overline{X}$ 14.72) were significantly higher than the pretest mean scores ($\overline{X}$ 8.81) with a mean difference of 5.91. With the use of multimedia technology, all the learners scored higher in the posttest than in the pretest with the

2-tailed significant value of 0.001. These indicated that there was an increase in learning achievement of the students in mathematics after using multimedia technology. Thus, the findings specified that the use of multimedia technology was effective in teaching mathematics to achieve better learning outcomes.

The finding of students' improvement in achievement was in line with the study carried out by Hasan, Bhatti, & GebreYohannes (2016) on the impact of multimedia in teaching mathematics. Their study showed that the multimedia-based teaching and learning process dramatically improved the performance of the students. It was also found out that the lesson presented in this way was more organized and comprehensible. This was also parallel to the study carried out by Naidoo & Hajaree (2021) on exploring the perceptions of grade 5 learners about the use of videos and PowerPoint presentations when learning fractions in mathematics. The result of the study showed that the use of PPT and Videos helped in creating an encouraging and conducive learning atmosphere resulting in learning fractions in a fun way, thus leading to enhancement in students' learning achievement. It was also found that students valued the use of technology-based learning.

2. Learning satisfaction

The second major finding of the study was that students exhibited positive learning satisfaction towards the use of multimedia technology in mathematics. The use of multimedia technology in teaching and learning mathematics was perceived as exciting, fun, and joyful. It was learned that it motivated and developed the participants' confidence in the subject. The content of the multimedia with rich vocabulary, graphics, and appropriate use of language eased students to understand and remember the lesson better. The interview result also presented that the students were highly motivated and exhibited positive learning satisfaction for the use of multimedia technology in teaching and learning mathematics.

This was parallel to the study carried out by Alkhasawneh (2016). The result showed that multimedia enhanced students' achievement and positive satisfaction in the mathematic subject. This research suggested multimedia could be used to facilitate mathematic learning and increase students' satisfaction. Furthermore, similar findings were also reported in research carried out in other subjects. For instance, the finding was in line with a study carried out by Subba (2011) on investigating the effects of using multimedia

technology (PPT and Video clip) in teaching geography to grade 7 Bhutanese students. The finding from his study indicated that students' learning satisfaction was positive with enhanced learning achievements. The findings also showed that many students favored being in a class where multimedia technology (PPT and Video clip) was used. Additionally, students' responses confirmed that there were no negative perceptions towards the use of technology in the class. Overall, the study indicated that the use of multimedia technology has positively affected students' satisfaction.

Both the research objectives had been addressed in this study, with actual teaching in support of using multimedia technology (video clip and PPT) for teaching and learning mathematics (fractions) in grade 5 Bhutanese classroom. The data collected through both quantitative and qualitative and results helped the researchers to clearly assess the students' learning achievement and satisfaction by using multimedia technology. The results of the study revealed that using multimedia technology was an effective teaching method and that was very much required in today's classrooms, especially in teaching and learning mathematics (fractions).

If schools implement multimedia technology, learners will possibly obtain better achievement in tests. Moreover, it helps students to comprehend abstract concepts in a simplified manner with fun and excitement. Therefore, the use of multimedia technology is regarded as one of the best alternative approaches in teaching to improve students' learning achievement and satisfaction in mathematics.

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