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

BY

RIGZIN

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Abstract

The mixed methods of quantitative and qualitative were employed to gather the required data to compare the students learning achievement and satisfaction before and after the use of multimedia technology in teaching mathematics in grade 5 Bhutanese classroom. 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 the 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. The recommendations to the study were concerned that teachers may also try teaching other topics in mathematics using multimedia technology to make their lessons interesting and engaging to enhance students' learning.

(Total 114 pages)

Keywords: Multimedia Technology, Grade 5 Students, Learning Achievement, Learning Satisfaction, PPT, Video Clips

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ABBREVIATIONS

Abbreviation	Meaning
BCSEA	Bhutan Council for School Examination and Assessment
DCRD	Department of Curriculum and Research Development
NAPE	New Approach to Primary Education
IOC	Item Objective Congruence
MoE	Ministry of Education
PPT	PowerPoint Presentation
TIMSS	Trends in International Mathematics and Science Study
PISA D	Programme for International Student Assessment for Development
BBE	Bhutan Board of Examination
RCSC	Royal Civil Service Commission
REC	Royal Education Council
SD	Standard Deviation

CHAPTER 1

INTRODUCTION

The study's background and rationale, research objectives, research questions, research hypothesis, scope, and limitation of the study are all covered in this chapter. It also includes operational definitions and the expected outcome of the study.

1.1 BACKGROUND AND RATIONALE OF THE STUDY

Bhutan, with a population of about seven hundred thousand people, is mostly a Buddhist country in the eastern Himalayas, situated between mighty China to the north and massive India to the south. Tobgay (2014) states that the seed of the modern education system was sowed during the reign of the first king of Bhutan Gongsar Ugyen Wangchuck in 1914 when forty-six Bhutanese boys were sent to India to pursue western education. As years rolled on the farsighted monarchs felt the significant roles of western education for the country's development. According to Takehiro (2015), the modern education system was endorsed in the first five-year plan in 1961 and started expanding through the country during the reign of third king Jigme Dorji Wangchuck. Thus, modern education made its way into Bhutan in the 60s making the country one of the youngest in modern education. Dukpa (2015) states "Mathematics had always been featured as a core and compulsory subject in the schools of Bhutan." Hence, formal and comprehensive mathematics education was established in Bhutan in the early 1960s, along with the launch of the modern educational system (Dolma, 2016).

Mathematics is known for its importance. Researchers across the world regard mathematics as a fundamental skill in education. Umameh (2011) states that mathematics education is a fundamental and indispensable tool for the scientific, technological, and economic advancement of any nation. Similarly, according to

Connes (2010), mathematics is the backbone of modern science and a valuable source of new concepts and tools for comprehending the reality in which we live and participate. It helps us understand complex ideas and prepares individuals to face the challenges of life. Similarly, Fallon, Walsh, and Prendergast (2013) state that in mathematics, children learn to deal with problems related to real-life situations that improve their ability to think and reason out logically, which prepares them for their future. Hence, it is evident that strong performance in mathematics can assure an individual to be successful at work.

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. Mullis, Martin, Foy, and Arora (2012) state that in 2011 Trends in International Mathematics and Science Study (TIMSS) carried out a study and it revealed that only three out of sixty-three countries improved at all four Advanced International Benchmark since 1995. According to Choden (2015), the result announced by TIMSS was alarming and raises a worldwide concern about inconsistencies in students' performance in mathematics and also in addressing the learning needs of students' efficiency. Similarly, most Bhutanese students consider mathematics the most difficult subject. A study carried out by Bhutan Board of Examination (BBE, 2008), revealed that Bhutanese students performed poorly in mathematics. The REC (2012) also found that with the majority scoring less than 50%, mathematics came out to be Bhutanese students' weakest subject. Also, the result of grade 3 and 6 students showed a similar trend.

As per BCSEA (2018) the overall mean score was 61.98 in English, 73.54 in Dzongkha, and 56.5 in Mathematics for the 2017 academic year. Similarly, BCSEA (2019) reported an overall mean score of 67.4 in English, 73.78 in Dzongkha, and 64.02 in Mathematics for the 2018 academic year. These reports showed that for two consecutive year's mathematics had remained the lowest-scoring subject among grade three Bhutanese students. The average mean mark of mathematics of two years (2017 & 2018) was lowest with 60.26 while comparing to 64.69 in English and 73.66 in Dzongkha.

Moreover, BCSEA (2018) reported an overall mean score of 54.33 in English, 57.96 in Dzongkha, 55.83 in Social Studies, 53.46 in Science, and 35.33 in Mathematics for the 2017 academic year. Similarly, BCSEA (2019) reported that the overall mean score of 46.86 in English, 55.48 in Dzongkha, 54.47 in Social Studies, 61.35 in Science, and 43.33 in Mathematics for the 2018 academic year. These reports showed that for two consecutive years, mathematics had remained the lowest-scoring subject among grade six Bhutanese students. The average mean mark of mathematics of two years (2017 & 2018) was lowest with just 39.3 while comparing to 50.6 in English, 55.2 in Social Studies, 56.7 in Dzongkha, and 57.4 in Science.

This was also shown in the performance assessment of three domains in PISA - D (Program for International Student Assessment for Development), candidates studying in both Classes IX and X performed better in Scientific Literacy with 41.78 and Reading Literacy with 37.41 mean score. The lowest was in Mathematical Literacy with 28.84 mean score.

Performance in mathematics might have been affected by various factors. However, many educators blame using inappropriate use of teaching methods as one core factor contributing to poor performance in mathematics. According to the Royal Education Council (REC, 2012), low math scores are primarily related to a fear of the subject and the teaching technique (chalk-and-talk and memorizing out of context). Students consider mathematics a boring subject and do not perform well due to the traditional method of teaching. Traditionally, the teaching of mathematics was deduced to teachers explaining the whole concept and methodology of solving mere numerical problems. There was limited importance given to the understanding of mathematical language, limited connection to a real-life situation, and limited scope for children to explore different approaches and methodology to problem-solving. The situation was aggravated with the stringent requirement for students to produce a correct result without due consideration of methods and analogies used to solve a mathematical problem.

With the introduction of New Approach to Primary Education (NAPE) in the mid-1980s, the teaching strategy was shifted from teacher-centered to learner-centered, yet traditional teaching is still prevalent in most schools. Traditional instruction is a structured classroom (more teacher-centered) where the focus is on the teacher leading the lesson rather than a two-way communication between the students and the teacher (Shelley, Swartz, & Cole, 2007). According to Peldon (2018), the traditional teaching approach demands the students to memorize the entire text which limits their understanding and thinking skills.

Similarly, misconceptions of mathematical concepts and lack of understanding of the fundamental principles adversely affect students' acquisition of concepts when encountering new mathematical performance tasks (Russell, O'Dwver, & Miranda, 2009). Usher (2009) also states that weakness in the fundamentals leads to inaccuracies and generalizations of mathematical concepts, and causes students to acquire a false sense of self-efficacy. Moreover, other factors like mathematical anxiety hamper the competency of students' performance in the subject. Sokolowski and Ansari (2017) state that the persons who have had math anxiety normally think that they are poor in mathematics and they hate the subject.

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 that is suitable for the current era, which will enhance the learning of mathematics is of paramount importance. Witzel and Riccomini (2007) state that mathematics teachers and instructional leaders are under tremendous pressure to increase the academic achievements of all the 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.

The way people communicate has been impacted by technology and this is also reflected in the literacy practices of students (Alison & Goldston, 2018; Walsh, 2017). A study done by Pew Research Center data (2018) found out that roughly 9 in 10

adolescents go online daily multiple times, and 95% of teens have access to a smartphone (Anderson & Jiang, 2018). As a result, the notion of literacy has evolved along with the technological advances, and "students right now require a repertoire of both print and digital literacy practices for their future workplace and life" (Walsh, 2017). Walsh (2017) also states that in today's era of digital society, "text" also refers to different forms of media from different types of digital online sources including social media, not just the printed word. As a result, it is critical to integrate multimedia in mathematics education, as it is expected to bring innovative practices, fresh styles, and access to the subject.

Multimedia technology does not only mean modern gadgets using Hi-Tech digital equipment, it also means simple things like short video clips, text, PPT, graphics, and many more. Multimedia-based technology includes multiple modes used to convey information to the learners (Vernadakis, Zetou, Tsitskari, Giannousi, & Kioumourtzoglou, 2008). McGraw-Hill (2003) states that multimedia technology applies interactive computer elements such as video, animation, sounds, graphics, and text. Media (PPT, Video, and text) can also present the information without an internet connection and present the information that cannot be accessible in the traditional classroom due to location, constraints of classroom size, and cost.

In this research, the term multimedia technology means the use of PowerPoint presentation (PPT) and short videos for learning 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. Forget about the use of PPT and short video clips, even simple media like recorded sounds, rhymes, and texts were also rarely used in the classroom of Bhutan, especially at the primary school level. Though most of the schools have projectors, however in most primary schools they remain underutilized since they are

used only for the sole purpose of conducting staff coordination meetings and parent-teacher meetings.

Incorporating multimedia-based technology as an instructional strategy has the potential to transform teaching approaches with maximum interactions between students and teachers (Zevenbergen & Lerman, 2008) in ways traditional instruction might not offer. Research investigating the effects of multimedia-based instructional technology on student achievement might be a beneficial influence on educators' decisions concerning the integration of interactive whiteboards into classroom instruction. Essential to improving education, educators should constantly reflect, revise, and examine new and improved instructional methods to enhance mathematics education for all students (Bonner, 2009). According to Dolma (2016), in Bhutan's 50-year history of education modernization, little study has been done on the efficiency of the education system in general, and mathematics instruction in particular. There has been no reliable proof of any study using multimedia technology to improve the capabilities and achievements of Bhutanese students in mathematics until recently.

Therefore, this study aimed at looking into the effectiveness of teaching mathematics through the use of interactive technology such as short videos and PowerPoint presentation. Everyday access to the information is increasing as well as the information access of the students is also increasing gradually. Also, teachers are increasingly searching for new effective ways through which they can teach more effectively and get benefit from the educational technologies to make the students learn more easily. Although many kinds of research have indicated the positive benefit of using technology in teaching, however, technology still in its infancy stage in Bhutan poses a challenge, especially in the teaching of mathematics subject. Thus, an urgent need is felt to ramp up the studies related to teaching mathematics using technology, especially at primary school level in Bhutan. Consequently, the researcher decided to examine the effectiveness of multimedia technology in classroom 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.

1.2 RESEARCH OBJECTIVES

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

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

1.3 RESEARCH QUESTIONS

1.3.1 Would there be any improvement in grade 5 Bhutanese students' learning achievement in mathematics (fractions) after using multimedia technology?

1.3.2 Would grade 5 Bhutanese students exhibit learning satisfaction in learning mathematics (fractions) after using multimedia technology?

1.4 RESEARCH HYPOTHESES

1.4.1 The learning achievement level of grade 5 Bhutanese students in mathematics (fractions) would be improved after the use of multimedia technology in the learning process.

1.4.2 The grade 5 Bhutanese students would exhibit positive learning satisfaction in learning mathematics (fractions) after using multimedia technology.

1.5 SCOPE OF THE STUDY

1.5.1 Location of the study

This research was conducted in one of the primary schools in Bumthang district, Bhutan's central region, which is a semi-urban area.

1.5.2 Population and Sample

The study's population were grade 5 students from one of the schools in Bumthang. The researcher utilized all of them as research participants because the research school only had one section of grade 5. Therefore, a total of 32 students with mixed abilities in mathematics and gender was chosen as the research participants. The age of the learners ranged from 11 – 13 years.

1.5.3 Content of the Study

In this study, the researcher taught a chapter (Fractions) from grade 5 mathematics text developed by the Department of Curriculum and Research Development (DCRD). This chapter consisted of four sub-topics. The researcher taught all the topics. Pretest was conducted before teaching the chapter and posttest after teaching using multimedia technology.

Table 1.1 Table of content for the lesson

Lesson Plan	Topic	Time
I	PreTest Explore: Meaning of Fraction	Third week of February, 2021
II	Fraction as decimal	Fourth week of February
III	Equivalent fraction	First week of March
IV	Comparing fractions and Posttest	Second week of March

1.5.4 Time Frame

The study was conducted for four weeks. The researcher taught one lesson in a week. Each lesson consist of 90 minutes; therefore, the researcher took 2 periods of 45 minutes in one week to cover a lesson. Each class had a period of 45 minutes each. Altogether, the researcher taught 8 periods in four weeks using multimedia technology in mathematics. The data was collected in the month of February and March, 2021.

Table 1.2 Time Frame for the Research Process

Activities	Research Time Frame			
	From		To	
	Month	Year	Month	Year
Literature Review	August	2020	December	2020
Research Proposal			January	2021
Data Collection	February	2021	March	2021
Data Analysis	March	2021	May	2021
Final Defense			June	2021

1.6 CONCEPTUAL FRAMEWORK OF THE STUDY

In this study, there are two variables; independent variable and dependent variable. Multimedia technology is the independent variable whereas students' learning achievement and students' satisfaction with the use of multimedia technology to learn mathematics are the dependent variables. The framework is illustrated below:

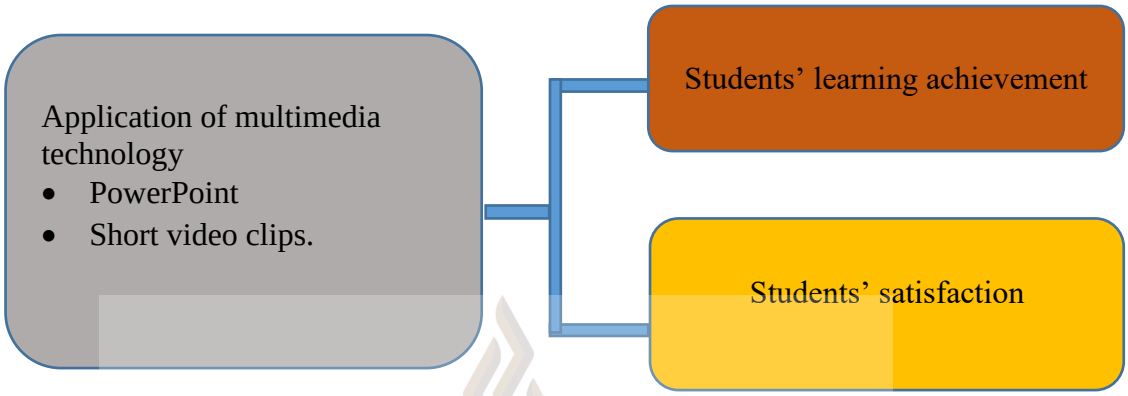

Figure 1.1 Illustration of the independent variable and dependent variables.

1.7 LIMITATION OF THE STUDY

1.7.1 The study was limited to a section of grade 5 students in one of the primary schools in Bumthang District, Bhutan. Therefore, the findings would not be generalized to the performance of all the grade 5 students in Bhutan.

1.7.2 The study was confined to the use of multimedia technology in teaching only Fractions. Therefore, it cannot reveal the performance of complete mathematics curriculum.

1.7.3 Only two different types of multimedia technology (PPT & Video clip) were used by the researcher, so the findings would not be generalized for other types of multimedia technology.

1.8 OPERATIONAL DEFINITIONS

Multimedia technology refers to the short video clips and PowerPoint used in teaching and learning mathematics (fractions) to the research participants.

Short video clips refer to the 4 to 6 minutes video clips (downloaded beforehand by the teacher) which are related to the topic of the lessons that will be shown to the students to make the concept clearer during the lesson.

PPT refers to a PowerPoint presentation that has 15 to 20 slides that the teacher will be using to make the lesson more effective. The teacher will make the slides attractive by adding some simple animation and design.

Learning Achievement refers to the scores of research participants in the achievement tests (pretest and posttest) in mathematics (fractions that includes 4 subtopics). It also refers to the learning achievement of the participants who have learned mathematics (fractions) using multimedia technology. This is to be assessed by achievement tests including pretest and posttest.

Learning Satisfaction refers to students' positive responses towards using multimedia technology in learning mathematics (fractions). The result of the students' interview measures the students' satisfaction towards the use of multimedia technology in learning mathematics (fractions). The data is to be collected from a semi-structured interview with the participants after the intervention.

Grade 5 students refer to the Bhutanese students studying in 5th standard; aged between 11 to 13 years old and they are the research participants of the study.

1.9 SIGNIFICANCE OF THE STUDY

1.9.1 The use of multimedia technology would exhibit better learning achievements in mathematics in grade 5 Bhutanese students.

1.9.2 The study would show positive responses regarding the satisfaction of students in learning mathematics by using multimedia technology.

1.9.3 The finding of this study would provide mathematics teachers an alternative to use multimedia technology as one of the inventive strategies to teach mathematics.

1.9.4 This study can be used as a reference for other teachers who want to include multimedia technologies into their mathematics classes. The study will serve as a foundation for teachers to use in helping students learn mathematics.

CHAPTER 2

LITERATURE REVIEW

This chapter presents the review of the literature related to the study to provide the theoretical background to understand the concept of mathematics and multimedia technology and its effectiveness in mathematics education.

It mainly talks about these topics: Mathematics curriculum of Bhutan; Concept of mathematics; Fractions; The theoretical background of multimedia technology; Conceptual framework for the use of multimedia technology in teaching; Benefits of multimedia in teaching; Related learning theories; and Review of related research of the strategy in use across different countries.

2.1 MATHEMATICS CURRICULUM IN BHUTAN

Formal and comprehensive mathematics instruction was introduced into Bhutanese schools with the rise of modern education in the early 1960s, under the supervision of the third King (Dolma, 2016). During those time the mathematics curriculum was entirely based on Indian curriculum and were taught by teachers from India. The modern teaching and learning methods associated with constructivist views were rarely practiced. Teachers gave students no or very little opportunity to construct their own knowledge and skills by actively participating in the learning process. As a result, nearly all students land up learning rules and procedures rather than relational and conceptual understanding. Every year, a decreased number of students chose to study mathematics at the university and college level, revealing a lack of conceptual knowledge (Dolma, 2002).

Choden (2015) states that curriculum is like the soul and lifeline of any education system. The comprehensive curriculum must consider different factors like

cultural, economic, ethnics, race, political, social, and moral of the society. Ministry of Education (2014), states providing quality education to every single Bhutanese student regardless of academic performance, gender, intellectual ability, socio-economic background, and special needs. Therefore, it is of paramount importance to develop a curriculum that meets the different needs of students while also adhering to national policies. Since the early 1990s, studies on teachers' professional development, pedagogical practices, and assessment in all the subjects had been conducted by various officials. For Mathematics the study was conducted in 2003 and 2004 and found the need to reframe the Mathematics syllabus from preprimary to secondary level. Hence, Bhutan's MOE initiated major mathematics curriculum reform for all the grades starting from pre-primary till grade 12 with the aim to enhance mathematic education in the country (Policy Planning Division, 2006).

CAPSD (2009) mentioned the new mathematics curriculum intend to fulfill the following objectives:

1) Develop related concepts, skills and contribute to work confidently in the areas of numbers, algebra, measurement, geometry, and data handling.

2) Develop the ability to think critically, strategically, and logically in varying contexts.

3) Develop the skills to structure and organize, work out procedures and represent and communicate information effectively.

4) Create models and predict outcomes to reason and justify, seek patterns and generalizations.

5) Make sensible guesses and compute with accuracy and use the step-by-step investigation to make interpretations.

The new mathematics curriculum was developed, organized, and planned integrating the only appropriate and necessary topics as per Bhutanese context. It meets current international trends and demands to go with the flow of the situation. Shifting the classroom teaching practice from teacher-centered to learner-centered, the

students' attitude about mathematics has changed from negative to positive. The curriculum also prepares students to face the challenges of this fast-changing world as every chapter focuses on the value-laden issues and social norms needed for every Bhutanese student (Tshewang, 2015).

2.2 CONCEPT OF MATHEMATICS

Famous mathematicians, philosophers, and recognized organizations have defined mathematics in different ways. "Mathematics is a branch of science, which deals with numbers and their operations" (Fatima, n.d.). Distionary.com (2005) defines mathematics as the study of relationships between geometric shapes, equations, fractions, and numbers. 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 which is more concerned 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. Everything we do starting from the morning until we go to the bed is mathematics (Gouba, 2008). Mathematics is used in people's everyday lives be it a carpenter or a doctor, an engineer or a farmer, a teacher or a student, a shopkeeper or a cook, a scientist or a musician. Mathematics is present unknowingly in all the different activities that we do in our daily lives, in one way or the other (Gouba, 2008)

Mathematics is vital to the maintenance of satisfactory living standard in order to make an informed decision and to strengthen the power of reasoning accurately using logical thinking. (CAPSD, 2005) states that mathematics prepares the learners to understand the world better with a dominant set of tools. Problem-solving skills, rational thinking skills, communication skills, and the ability to reason abstractly are

among these tools. The importance of mathematics is parallel to the development of technology as mathematics is what actually computer does. Mother nature is the greatest mathematician as the concepts, shape, laws, patterns, size, and many others are found in nature and mathematics is the backbone of all science (Sushmita, 2012). Hence, it is important to have a mathematics curriculum as a core subject in any educational institute in the world. Fatima (n.d.) states that we can understand the importance of mathematics by looking at how Galileo defines it. In his definition, he states mathematics as 'a language in which God has written the world'.

Ernest (2010, as cited in Larson, 2018) has provided three main reasons for teaching mathematics:

1) Necessary Mathematics - mathematics that is required for employment and economic growth. For this reason, Ernest incorporates functional numeracy, practical and work-related information, and advanced specialist knowledge.

2) Social and Personal Mathematics – mathematics with a personal and social focus. Ernest incorporates mathematical problem presenting and solving, mathematical confidence growth, including mathematical tenacity, and social empowerment using mathematics in this case.

3) Appreciation of Mathematics as an Element of culture – the significance of recognizing not only mathematics but also its role in history, culture, and society in general.

2.2.1 Assessment of Grade 5 Mathematics

Assessment is an integral and continuous process in measuring learners' progress and performance toward establishing learning outcomes which provides feedback towards improving the learning. There are two types of assessments, formative and summative. Formative assignment is assessment for learning and summative assignment is assignment of learning.

Table 2.1 Continuous Assessment of Grade 5, Mathematics

Types of assessment	How	Why
Formative (40%)	• through unit revision • everyday observation • formal or informal interviews to reveal students' understanding • journals in which students comment on their mathematical learning • short quizzes • projects • maintaining a portfolio of work	To check students' learning and give continuous feedback which can be useful for the teacher to further enhance his or her teaching thereby improving students' learning.
Summative (60%)	• unit test • term exam • the performance task • short quizzes • projects	To see what students have learned and is often used to determine a mark or grade.

2.3 FRACTIONS

Word 'fraction' is a Latin word 'fractus' which means 'broken'. It represents a part of a whole or usually, any number of equal parts. As per the Encyclopedia of mathematics (2010), "a fraction is a number consisting of one or more equal parts of a unit. It is denoted by the symbol a/b, where a≠0 and b≠0 are integers. The numerator 'a' of a/b denotes the number of parts taken off the unit; this is divided by the number of parts equal to the number appearing as denominator 'b'. A fraction may also be considered as the ratio produced by dividing 'a' by 'b'". In a layman's words, a fraction says how many parts of a certain size are there. Some of the simple examples are one-half, two-thirds, three-quarters, three-tenth. According to iPractice Math (n.d), a part of a whole is called a fraction. It also shows the ratio between two integers which is separated by a vinculum (-) or a solidus (/). The numerator is the number at the top of the vinculum, and the denominator is the number below the vinculum.

According to Math-Only-Math.com (n.d.), basically fractions are divided into three categories: proper fractions, improper fractions, and mixed fractions.

1) Proper fraction: If the numerator of the fraction is greater than its denominator, it's called a proper fraction (Numerator < Denominator).

Example: $^{1}/_{2}$, $^{3}/_{5}$, $^{20}/_{99}$, $^{101}/_{1000}$, …

2) Improper fraction: If the denominator of the fraction is equal to or greater than its nominator, it's known as an improper fraction (Numerator = Denominator) or, Numerator > Denominator).

Example: $^{3}/_{2}$, $^{7}/_{5}$, $^{99}/_{99}$, $^{1000}/_{211}$, …

3) Mixed fraction: A mixed fraction is a fraction that combines a whole number and a proper fraction.

Example: $3\frac{4}{5}$, $7\frac{21}{23}$, $100\frac{3}{7}$, $56\frac{9}{101}$…

Introducing and teaching the concept of the fraction at a young age is essential for all students. The foundation to other mathematical concepts that are learned in higher classes starting from algebra to calculus is a fraction (Siegler et al., 2012). As its building blocks for other mathematical skills, it is very important to make students feel comfortable and confident about their understanding of fractions. Hennich (2009) states nature of numbers and their interactions can be very well understood by students if they have sound knowledge and idea about fractions. Other topics like probability, statistics, and rates of change need a very good conceptual knowledge of fractions. Siemon (2003) states that critical conceptual link of mathematical stands such as measurement and geometry are also supported by a fraction, besides other number-based features of mathematical understanding.

There are many ways to infuse the concept and understanding of fractions to our students. For example, to help students understand better and reduce the natural

number biasness, a teacher can use manipulatives, visual models, and technology in a fraction lesson (Fazio & Siegler, 2011). Also, a teacher can teach it by using real-life examples. Hannich (2009) “One of the best times to practice using fractions is during cooking. Such as showing a child how fractions are used in cooking recipes (e.g., 1/3 cup of sugar), can help to measure out the required quantities”. Therefore, it is important to teach our students by having them relate to their personal experiences and letting them make connections to real-life situations.

2.4 MULTIMEDIA TECHNOLOGY

The word multi-media is the combination of two words ‘multi’ and ‘media’. In simple terms, multi implies to two or more, and media is the plural form of medium. Medium refers to multiple levels of abstraction after the storage, transport, communication, representation, display, input interaction, and perception of any information. The term multimedia is entirely used for describing many 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. Any information content processing devices, such as computers and electronic gadgets, can record and access it.

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. The visual material may be a diagram, picture, graph, movie, or animation while words may be spoken or in the form of written text. Seth (2009) defines multimedia as learning using hardware like a blackboard, radio, tape, television, projector, and software like films, a teacher made diagrams, models, slides, graphs, cartoons, maps, real objects, and photographs. Multimedia, according to Pavithra (2018), is the computer-controlled amalgamation of text, graphics, drawings, still images, video, animation, audio, and any other media in which many different types of information can be seen, saved, transferred, and handled digitally. It can also be displayed, interacted with, or accessed by modern and mechanized information processing systems. It can also be used as part of a live show. Electronic media used

for storing and presenting multimedia material are known as multimedia devices. As per Shaikh (2011), the term multimedia is referred to a combination of media which includes photos, video, audio, and text in a special a where it can be accessed interactively and delivered electronically. He also states that “Multimedia is a blend of some or all forms such as text, data, images, photographs, animation, audio, and video, which are converted from different formats into a uniformed digital media and is delivered by computers”.

Though multimedia technology has been defined in many ways by different personal, in Bhutanese classroom multimedia means the use of tape recorder, chalk and chalkboard, globe, chart, videos, audio, and PPT. The researcher in this study associates multimedia technology with the use of short video clips, text, and PowerPoint presentation (PPT) in teaching mathematics ‘Fractions’ to grade 5 students (research participants) in a Bhutanese classroom.

2.4.1 Instructional multimedia technology

Technology today has gained substantial attention in the educational fraternity around the globe owing to its huge possibility to aid teaching and learning in the course of last two decades. The combination of various forms of media in the instructional process in teaching and learning is called instructional multimedia. According to Fu (2013, p. 12), instructional technology includes electronic delivery systems which is extensively used in the contemporary education arena such as computer, radio, internet, television, and projector among many others. The appropriate use of instructional multimedia technology can raise quality of education and make learning realistic to a real-life situation. Using instructional multimedia technology and a digital environment expands students to access beyond classroom walls by creating opportunities that were not there before (Wong & Tatnall, 2005). The combination of visual and verbal codes presents information using multimedia-based instructional technology that is beneficial for students learning. (Wiebe & Annetta, 2008).

Additionally, instructional multimedia technology is basically used as a tool for students to enhance their achievement. Gallegos-Butter and Schneider (2004) suggested that dual-coding theory should be examined by instructional leaders as a theoretical tool for instructional technologies, it combines several modalities that enhance students' achievements. The learning achievement of students is enhanced when the instruction is provided by using more than one type of technological communication medium with a computer to present information. The media materials used by the teacher to achieve the instructional objectives by the students is known as instructional media (Scanlan, 2003). The types of media are audio, video, text, and graphic communication (Kingsley & Boone, 2009; Sidhu, 2009).

The demand for a change in style and method in teaching and learning with the use of instructional multimedia technology is felt globally in the post-21st century period. When technology is integrated into the classroom, learning becomes more engaging and exciting. 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. However, one must be mindful in selecting appropriate media to be used in teaching and learning as every media has got its own effect on both students and teachers.

2.4.2 Multimedia technology in teaching and learning

Teachers endlessly search for ways that are effective to sustain students' interests during teaching and learning processes. It is found that students learn better when they were taught using both words and pictures than only using words. Thus, the use of multimedia in education provides a platform to present the combination of words and pictures simultaneously leading to an effective learning outcome. Further, Puteh and Shukor (2010) reveal that integrating multimedia elements in teaching and learning has a positive impact on students, paying more attention and participating actively in activities making learning more interesting.

Today, in educational institutions, multimedia has forged its way in one or another form as a tool of educational technology. Multimedia has overcome time and place constraints to become a technology that can be used anywhere to facilitate multi-disciplinary people. With multimedia simulation, the acquisition of knowledge becomes more efficient for students. Since the information is presented in a variety of formats, multimedia applications enhance the learning experience and make learning easier for students by allowing them to grasp the knowledge more easily (Singh, 2007). Multimedia technology empowers the educational process by allowing teachers and students to interact more. It provides teachers to make teaching and learning materials for students in a better and inclusive way (Milkova, 2012). Hence, it is supposed that when technology is used in an appropriate way in classroom teaching, it creates a positive impact on students' achievement. Furthermore, use of technological tools in teaching support teachers in providing instantaneous feedback to student. This will encourage students to participate in active learning, teamwork, and cooperation. Furthermore, it assists teachers in providing students with individualized learning opportunities and flexibility.

According to Zimmer (2003), using multimedia technology in instruction allows students to take more active role in learning because they could see the experiment in action. Besides gaining information quickly and efficiently, students also engage themselves in learning with full attention and were provided additional opportunities to explore more through diverse channels. Consequently, the classroom environment becomes positive and conducive. The learning was enhanced because using multimedia technology provided a platform for more interaction between students and teachers and amongst students themselves. Hence, the researcher concluded using multimedia technology in teaching can promote better learning opportunities.

2.4.3 Multimedia technology and teaching mathematics

One of the most exciting contemporary innovations today is perhaps the multimedia technologies. The fast evolution of multimedia technologies over the

recent years have brought important changes to learning mathematics, in particular and educational system as a whole. Looi and Lim (2009) state that many researchers have supported the use of multimedia technology for teaching mathematics because of the promise it offers in resolving perpetual problems in teaching mathematics to young students. It creates a suitable learning context that enables a learner to control the learning environment. Selection of learning activities that proficiently use technology for graphing, visualizing, producing multiple representations, and computing is very essential in enhancing the students' learning opportunities. These interpretations were reinforced by researchers in the area of mathematics education who validates that multimedia technology have positive impacts on students' learning in student-centered instruction as opposed to teacher-centered instruction (Hong & Koh, 2002). Similarly, Yu, Lai, Tsai, and 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.

Teaching through multimedia technology has the ability to stimulate different senses of the learners. It was known to be an innovative and effective teaching and learning tool as it helped students to motivate their learning process and helped them understand the information better. According to Ruthven and Hennessy (2002), students were able to identify their increased motivation in completing mathematics activities faster, and increasing their productivity when they were taught incorporating technology. Ruthven and Hennessy's earlier research was confirmed by Sheehen and Nillas (2010) by stating that, "students reported the use of technology helped increase their motivation and engagement" (p.79). Hence, it is evident that the use of multimedia technology in teaching mathematic positively effects students' learning achievement.

2.4.4 Dales cone of Experience

Dale's Cone of Experience is a theory that combines numerous theories on how people learn and teach. According to Dale (1972), most of the students in schools had difficulty in learning how to reason, discover, and resolve real life issues. in most

schools, students were obliged to memorize facts and knowledge by rote. As a consequence, whatever knowledge the students learnt remains unused in the students' day to day lives. So to overcome this, Dale contended that there has to be radical methods to advance the quality of educational learning environments. Hence, he encouraged the use of audiovisual resources, believing that it can assist rich and unforgettable learning experiences and distribute them regardless of time and place constraints. Dale (1969) argued:

> "Thus, through the skillful use of radio, audio recording, television, video recording, painting, line drawing, motion picture, photograph, model, exhibit, poster, we can bring the world to the classroom. We can make the past come alive either by reconstructing it or by using records of the past. (p. 23)"

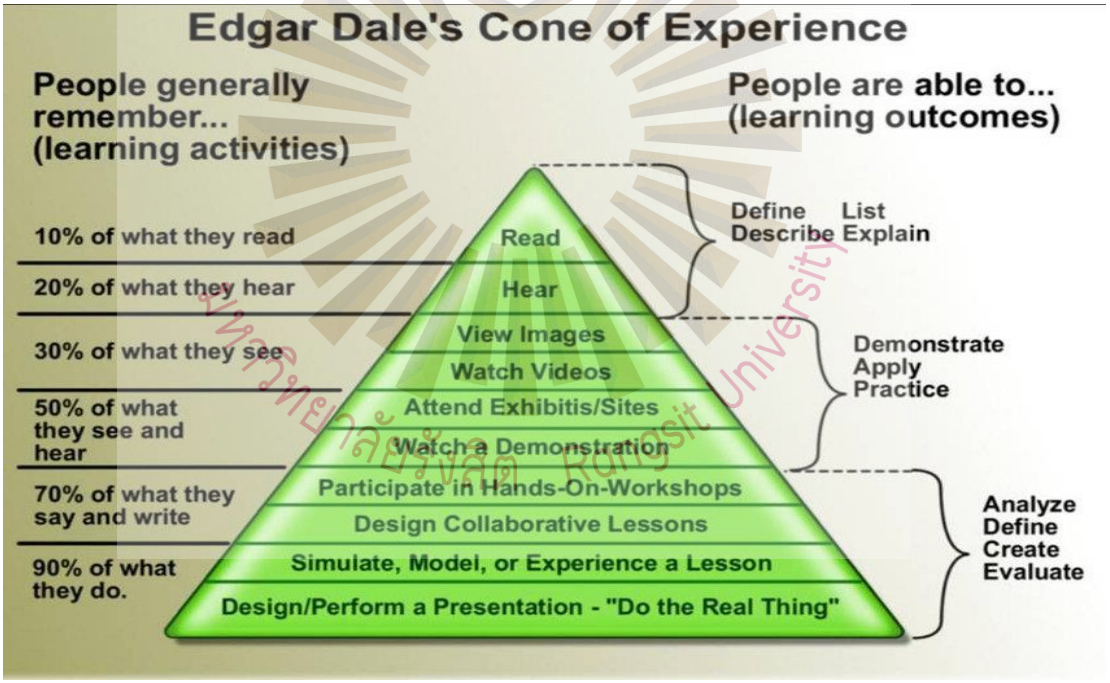

Figure 2.1 Illustration of Dale's cone of Experience

Source: Pastore, 2003

The Cone of Learning, created by Edgar Dale, is a graphic representation of learning modalities. The main goal of this graphic is to demonstrate the difference between active and passive learning. In addition, the shape of the cone and movement

from the bottom to the top is not related to comprehension, but rather the degree or levels of learning that occurs when you combine and engage learning modalities—reading, hearing, seeing, doing.

Unlike conventional method of teaching, use of multimedia technology in lessons make it more student-centered and realistic. Use of multimedia technology in teaching and learning entails that students engage in viewing images, watching videos and listening to audio during the lesson. It engages the learning modalities like reading, hearing, seeing, doing, etc. According to Dale's cone of experience it is elucidated that when students get chance to see images, watch videos, hear audios, take part in collaborative activities, and do their work on their own they will be able to retain and remember 50 to 90 % of the content of the lesson. It facilitates the students' participation in the lesson whereby the students can apply and practice the skills learned. On top of that, students can not only analyze, and evaluate what they have learned they can also replicate and use what they have learned in new scenarios.

2.5 CONCEPTUAL FRAMEWORK FOR THE USE OF MULTIMEDIA TECHNOLOGY IN TEACHING

This study zeroes in the use of multimedia technology in teaching mathematics by promoting the idea that the classroom use of multimedia is a critical factor for student academic achievement. It is with the hope that the use of multimedia will provide clear and simple information with immediate feedback from teachers and would enhance student's perception of technology subsequently increasing the achievement of students. It is partly based on Weiner's Attribution Theory, which states both external and internal factors can influence student achievement, with multimedia use being an external factor and students' perception of multimedia being an interior factor.

2.5.1 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 positive effect on

teaching and learning. Some of the standards that need to be considered while selecting multimedia are:

1) 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. The content must be viewed from all angles to avoid any loopholes and to suit the interest of the students. As stated by (Stephens et al. 2012) the media that we use should be tempting and inspiring for the students to watch and simultaneously be rich in content. One should also be mindful about the content being not bias and racist as mentioned by (Bello, 1999). Also, the content should be culturally appropriate for the learners and it must offer the platform for discussion, reinforcement, and study of the values.

2) Students' Age and Interest: Any media chosen must be appealing to the students and must motivate the students to learn. Students' interest depends on their age and interest. For instance, the video which was enjoyed by 10 years old may not be enjoyed by an adult of 45 years and vice-versa. This was supported by (Lopez, 2016) who states that the right choice must be made depending on students' like and age. Appropriate media will enhance the students' interest and foster their learning.

3) Clarity of Message/Language: The language ability level of the students and the clarity of the media need to be considered while choosing any media. English being a foreign language an accent and the language used in the media may pose problems to the students. Therefore, while choosing the materials teacher must be mindful about choosing based on an appropriate level of the language used and the opportunities they provide to the students.

4) 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. The teacher while choosing or preparing the media he/she should make sure the pace of the media should not be affecting the learning outcome of the lesson.

5) 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. The size of the letters, shapes, images, and color combination in terms of PPT too should be taken care of as mentioned by (Lopes, 2016) the images in the media must be clear and understandable.

6) 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. To maximize the concentration of the learners it is best to present media in short segments (Botirca, 2007). According to Guo et al (2014), the average engagement time of the students to watch media is close to 100% when the length of media is less than five minutes and it drops with the lengthening of the length of the media. An average engagement time with 9-12 minutes media is about 50% and 12-40-minutes media is about 20% only.

2.5.2 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:

1) 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. Also, the activities such as discussion on the title of the media, prediction of the content of the media, pre-teaching of any new vocabulary, and getting ready with the media (PPT & videos) presentation materials should be done. Lopez (2016) states that these activities help the students to get ready for the lesson.

Teacher can use multimedia to gain students attention, tell the objectives of the lesson, or to pre-teach new vocabulary as per their suitability and need of the lesson.

2) 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. A teacher can also take it as an opportunity to pause the media and pose some questions to check their understanding and participation. A teacher can make use of multimedia to teach actual lesson (concept), for conducting activity, to follow-up the activity, or to provide additional information according to the need.

3) Post-Use: According to Cakir (2006) this is the activity that offers the students chance to communicate, share ideas, and gradually built team. 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. A teacher can mainly use multimedia to evaluate the lesson, close the lesson, to provide homework, or to provide additional information according to the need of the lesson.

2.6 BENEFITS OF USING MULTIMEDIA TECHNOLOGY IN TEACHING

The growth in use of multimedia in teaching and learning purposes has fast-tracked recently and looks like it going to continue expanding in the near future. The role that multimedia application is going to play in today's education system is undeniable. Teachers discover methods to increase students' interest and motivation by use of educational multimedia applications. Students can actively participate in the learning process by using multimedia programs such as CD-ROM-based textbooks, tutorials, and laboratory experiments (Yadav, 2006). Multimedia application help students learn more effectively. It is more appealing than traditional techniques of

learning. The way teachers teach and students learn will undoubtedly be influenced by this new learning style. Hence, the following are the benefits of using multimedia in classrooms put forward by Wang.

According to Wang (2010), the following are the benefits of using multimedia technology:

1) Multimedia technology gives students the flexibility to access learning resources at their own convenience.

2) Students can learn at their own pace without relying on an instructor with multimedia learning.

3) Text, music, visuals, and animations can be used to target a range of learning styles.

4) Multimedia learning experiences blend concrete ideas and abstractions with visuals, texts, and audio presentations in a sequential order to meet the three essential characteristics of human learning: practice, observation, and thought.

5) Hyperlinks in multimedia technology help students find additional and relevant material, creating a dynamic learning environment.

6) Graphics, animations, and design attract learners' interest and motivate them to learn.

7) When used alongside with traditional educational techniques, multimedia technology enhances both the interactivity and the benefits of multimedia technology.

2.7 RELATED LEARNING THEORIES

Learning theories are important to education because they help teachers to understand and meet students' needs. Each learning theory provides its own explanations about learning and specifying the connection between what is learned and the conditions under which learning occurs (Mugisha, Christopher, & Mugimu, 2014). They give a deeper insight into students' prior knowledge and guide teachers

to use appropriate methods to further enhance learning. Yangdon (2015) states that learning is one of the most important activities in which humans are involved throughout their lives. Learning theories act as a conceptual framework that describes how information is absorbed, processed, retained, and retrieved during the learning.

2.7.1 The Cognitive Theory of Multimedia Learning

Students can learn more profoundly from words and pictures together than from words alone, according to the basic principle of multimedia learning. This fundamental principle may explain why so many individuals are able to learn new hobbies or talents by viewing YouTube videos. When a novice learns how to knit by viewing a video of an expert knitter making a scarf, for example, the learner follows along with the expert's spoken explanation to understand and learn. The basic principle looks so simple and obvious that we prefer choosing textbooks with charts, diagrams, maps, and illustrations. As a result, the rationale for using PowerPoint or movies in our classrooms is clear. According to Mayer and Moreno (2003), the principle of Cognitive Learning Theory of Multimedia learning propounds that meaningful and effective learning takes place when students involve with visuals and audio than from audio alone. This theory has three underlying assumptions.

1) Dual-channel: This assumption states that when dealing with information from sensory memory, there are two different channels: auditory and visual. Chen, Chun, She, and Wang (2009) states that people use separate channels to interpret visual and aural information independently in the dual-channel supposition. Humans use the verbal/audio channel for processing aural input and the pictorial/visual channel for processing visual input.

2) Limited capacity assumption: This assumption states that there is a limited working memory capacity for each channel. According to Mariano (2014), this supposition says that individuals have limits in the amount of information, or load that can be processed in either of the dual channels at one time.

3) Active processing: This assumption states that multimedia learning is an active method of choosing words, picking images, organizing words, organizing images, and mixing them together and with previous knowledge from long-term memory. Active learning involves people paying attention to relevant incoming information, organizing selected information into coherent mental representations, and merging mental representations with other knowledge (Chen et al., 2009).It explains that learning is an active process and meaningful learning happens when the learners have the opportunity to learn with verbal and visual presentations.

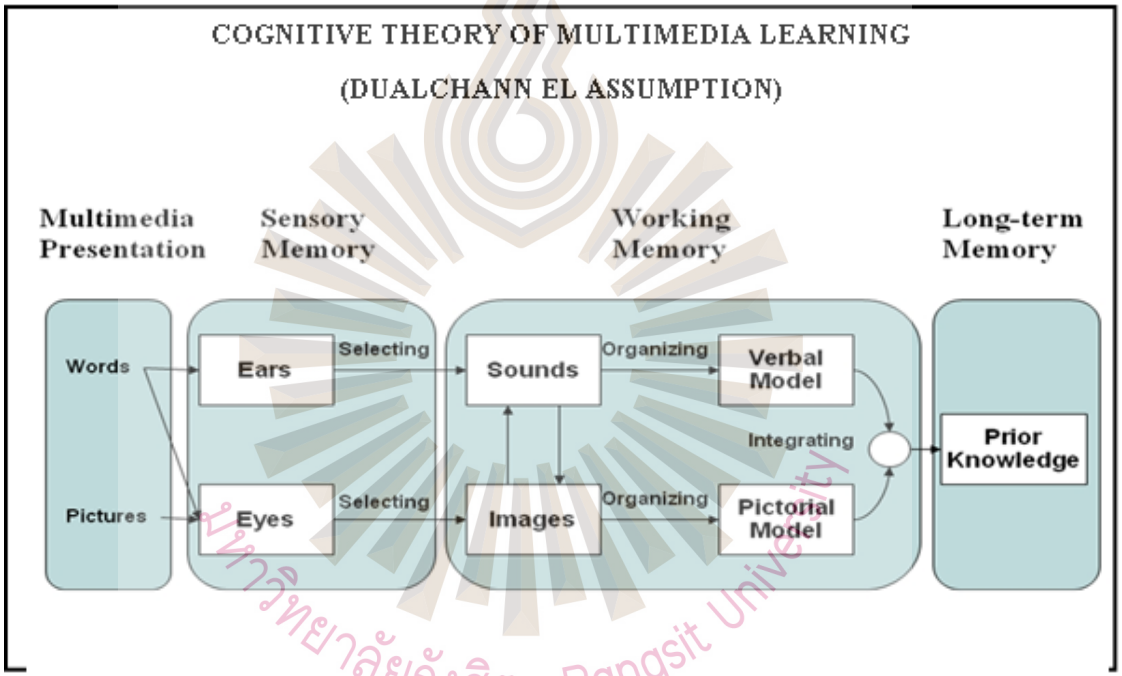

Figure 2.2 Illustration of Cognitive Theory of Multimedia Learning

Source: Mayer & Moreno, 2003

According to Mayer (2005), The Cognitive Theory of Multimedia Learning integrates several principles in relation to the above three assumptions. These principles emphasis on how to plan instruction using multimedia taking into consideration the facts about the cognitive processes and limits of the working memory, so as to enhance meaningful learning (Mayer, 2005). Lopez (2016) mentions that the learners remember 10% from the reading, 20% from the hearing, 30% from

the seeing, and 50% from the hearing and seeing. So, Cognitive Theory of Multimedia Learning rightly supports the learning through multimedia because most of the multimedia provide both image and audio to process information using both (auditory and visual) channel.

2.7.2 Constructivism

The constructivist teaching and learning theory plays a significant role in contributing to the processes of teaching and learning. It is a well-established learning theory that describes how knowledge is acquired by the people. Bada (2015) states that constructivism is a theory which emphasizes that individual learner will try to make use of all the information that they perceive and construct their own meaning from that information. In the theory of constructivism, knowledge cannot be passively received but built by the learners based on their experience because constructivist believes every learner is an active doer, not the passive listener. The constructivist focuses more on knowledge as a process and not as a product (Jones & Brader-Araje, 2002). In mathematics constructivist's view has led to a teaching approach which emphasizes on students to actively engage in mathematical task and let them construct their meaning. A teacher's role in mathematical learning is to create an atmosphere that allows students to construct mathematical knowledge. In such a learning environment, learners would be provided with the opportunities to assume, use their prior knowledge and experience, examine their reasoning, work with materials, and communicate their understanding for the purpose of construction of mathematical knowledge.

Likewise, Piaget was one of the first to put forward the notion that learning occurs through 'construction' of new knowledge when learners are actively involved in learning (Gould, 2012). It focuses on student-centered learning where the learners interact with society and construct the knowledge socially. It is assumed that learners use previous knowledge and concepts to help them in their acquisition of information. According to the constructivist approach, instructors' work is to act as facilitators and

not teachers. However, while designing any learning environment, it should support and challenge learners' thinking.

Using a timely strategy at the right time to get a positive outcome is very important in any situation. Therefore, the researcher felt the use of multimedia technology will be the correct treatment of the time when the performance in mathematics is evidently shown below expectation throughout the country. Therefore, through the researcher's experience of teaching mathematics in Bhutan, one vital reason for students' low performance in mathematics could be due to the teaching-learning practices adopted by teachers in the classrooms. Hence, the use of multimedia technology is seen as one of the alternatives to change students' perceptions towards learning mathematics and enhance learning achievements in the subject.

2.7.3 Theory of Multiple Intelligence

Intelligence is defined in a variety of ways. It's often referred to as intellectual potential; something we are born with, something that can be assessed, and something that's hard to modify. Each person possesses each intelligence to an extent, but there is always a primary, or more dominant, intelligence. Zhou and Brown (2015) acknowledge that Gardener's Theory of Multiple Intelligence believes that human beings are gifted with nine different types of intelligence, and it challenges the earlier view that intelligence is fixed throughout one's entire life. Multiple intelligences refers to a set of abilities, talents, or mental capabilities that everyone possesses to some degree. The theory multiple intelligences describes the various methods in which people learn and acquire knowledge. These intelligences include everything from using language, mathematics, visuals, and music to the value of social relationships, reflection, physical movement, and being in tune with nature. Gardner (n.d.) proposed that there are eight distinct intelligence kinds. He's also recommended for the addition of a ninth, dubbed "existentialist intelligence." Each intelligence is briefly described below:

1) Visual-Spatial Intelligence: Spatial intelligence is defined as the ability to accurately observe the visual world by converting, altering, and recreating components of one's own individual real reality. People with visual-spatial intelligence are usually good in remembering directions, maps, charts, videos, and pictures. It is found that even people who are visually impaired do have spatial intelligence. Spatial intelligence include mental images, spatial reasoning, visual talents, and imagination. Arnold and Fonseca (2004) state that many students understand better when taught using colorful teaching learning materials such as charts, pictures, drawings, slides, posters, and movies.

2) Verbal- Linguistic Intelligence: People with linguistic-verbal intelligence are very good at using words, both in written and spoken. People with this personality type excel in composing stories, memorizing facts, and reading. People with this intelligence are characterized by their ability in remembering the information which are either in print or spoken easily. They relish reading and writing activities, debating, or delivering influential talks and they can elucidate things extremely well.

3) Logical-Mathematical Intelligence: This is the ability to calculate, quantify, deliberate statements and hypotheses, and do actions that necessitate complete mathematical processes. It enables a person to recognize connections and relationships while also allowing them to use abstract, symbolic thought, sequential reasoning skills, and inductive and deductive thinking processes. People with high logical-mathematical intelligence, according to Cherry (2019), are skilled at spotting patterns, reasoning, and rationally investigating problems.

4) Bodily-Kinesthetic Intelligence: This intelligence refers to a person's ability to process information physically through movement, control, and expression of the hands and body. Bodily-kinesthetic people like information they can process bodily over other forms. People who are good at games and sports, performing arts especially dancing have high bodily-kinesthetic intelligence. According to Lunenburg, F. and Lunenburg, M. (2014), students' intelligence in this field can be

improved by providing physical activities like hands-on learning, acting out, role-plays, and physical relaxation exercises with equipment and real objects.

5) Musical-Rhythmic Intelligence: It is the ability to distinguish pitch, rhythm, timbre, and tone of sound and music. This intelligence allows people in identifying, creating, reproducing, and reflecting on music. This intelligence is found in people like composers, conductors, musicians, vocalists, and people with sensitivity in listening. The development of musical intelligence may be based on practicing singing, humming, whistling, tapping feet, clapping hands, or listening (Peters, 2015).

6) Interpersonal Intelligence: Interpersonal intelligence is the capability and skill of a person to socialize, communicate and interact with others. It requires effective verbal and nonverbal communication skills. On top of that the ability to empathize and sympathize with others, understanding their moods and temperaments, and the capacity to accommodate different viewpoints. People like teachers, social workers, actors, and politicians are said to have interpersonal intelligence. According to Hershcovis and Reich (2011), having interpersonal intelligence is the potential for working with others, understanding people, communicating with others, resolving conflicts, organizing, and leading others.

7) Intrapersonal Intelligence: This is the ability to understand oneself and be aware of one's own thoughts and feelings. It's also the capacity to put that information to good use in planning and conducting one's life. Intra-personal intelligence necessitates an understanding of oneself and the human condition. The ones who possess this intelligence can know their feelings and thus they can motivate themselves.

8) Naturalistic Intelligence: Naturalist intelligence is the capability in discriminating among living things and being sensitive to other aspects of natural world. This ability was evident significantly in our evolutionary past as hunters, gatherers, and farmers. It is still practiced today in jobs like botanist and chef. Furthermore, it is assumed that much of our society which is full of consumerism

make best use of naturalist intelligence because such intelligence is required while choosing automobiles, sports gears, cosmetics, and many more.

9) Existential (life smart): It is the ability of a person to deal with the philosophical questions in relation to life and its purpose. Learners with this intelligence learn better by making connections across the curriculum and involving with the community.

Every individual is said to have all the nine kinds of intelligence, although the degrees could vary from one person to another. Therefore, they are not mutually exclusive. Helena and Sreenidhi (2017) state that all intelligences are used at the same time, each complementing the other in the process of people developing skills to resolve issues. Learning through textbooks takes care of only linguistic approach to learning but an integration of multimedia in teaching and learning processes incorporate multiple aspects of intelligence such as visual/spatial, linguistic/verbal, logical, and musical, offering greater room to address a broader range of learners' needs. Hence, teaching and learning through multimedia is closely related to Gardner's Multiple Intelligence learning theory.

2.8 RELATED RESEARCH

A wide range of studies has been conducted to examine the effectiveness of multimedia in enhancing the learning achievement and attitudes of students. This section provides a review of the related research conducted using multimedia technology in enhancing students' learning achievement and satisfaction.

Naidoo and Hajaree (2021) carried out a study to find out the perceptions of Grade 5 learners on the use of videos and PowerPoint presentations when learning fractions in mathematics. The study was carried out in one of the primary schools in South Africa and the data was collected through a task-based worksheet, interactive technology-based lesson, and focused group interview. The findings of the study revealed that the use of PPT and Videos helped in creating an encouraging and

conducive learning atmosphere resulting in learning fractions in a fun way. Furthermore, it was also concluded that students valued the use of technology-based learning.

Alkhasawneh (2016) carried out research to investigate the effects of multimedia–aided teaching on achievement and satisfaction in mathematics of children of kindergarten. The sampling comprised of 60 kindergarten students and were divided into an experimental and controlled group. The controlled group was not exposed to a multimedia presentation while the experimental group was taught using multimedia presentation. The researchers have applied a quasi-experimental design for the study. After the treatment, an analysis of covariance was performed to assess whether the treatment group had higher mathematical achievement than the controlled group based on mean mark of posttest. The mean of post-test scores for the group using multimedia (16.06) was higher than the mean of post-test scores for the group using the traditional method (14.63). The result showed multimedia enhances students' achievement and attitude in mathematic subject. This research suggested that multimedia can be used to facilitate mathematic learning and increase students' achievement.

Hasan, Bhatti, and GebreYohannes (2016) carried out research on the impact of multimedia in teaching mathematics. The researchers' special interest was on the impact on students' performance and attitude towards multimedia while teaching Calculus and Numerical Methods using multimedia. An experiment of two equivalent groups (experimental group and controlled group) was designed with 25 students each from Coventry university Module students of Middle East College (Oman) who were taking the module calculus and numerical methods. Both groups were treated for a period of 10 weeks. The data collected through pre-test and post-test from both the groups were organized and analyzed using a suitable statistical instrument. The result showed that the students' performance on the module calculus and numerical methods was drastically enhanced as a result of the multimedia-based teaching and learning process. It was also revealed that the lessons presented in this way were more organized and comprehensible. Therefore, the researchers finally came to the

conclusion that multimedia-based teaching and learning is more effective than traditional methods of instruction.

Eyyam and Yaratan (2014) investigated the effect of the integration of technology in mathematics lessons on students' achievement and satisfaction. Two classes were used (experimental class and controlled class). Both experimental and control group finished a pretest before the intervention was used a posttest after the instruction. The researchers planned and made available instructional technology to the teachers that were to be used while teaching in the experimental group. While the control groups were taught using traditional method. To make it fair, researchers chose a completely new topic to be taught and assigned to the teachers who frequently taught these lessons at the school with the lesson plans. In the experimental group, the teachers were allowed to use a laptop with connected with LCD projector. PowerPoint slides, films, images, flashcards, animations, and other media were used to teach the lesson. The findings showed that many students favored being in a class where educational technology 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' achievement and satisfaction.

In another research carried out to investigate the impact of using multimedia pedagogical agents on students' achievement and attitude, Kolak and Ozan (2012) found that it enhances students' learning achievement irrespective of the kinds of animations used. The finding showed that students' learning achievement and attitude were positively affected by the use of multimedia. It was observed that learners who had the opportunity to use the software performed significantly better, whereas there was no significant difference in terms of animated pedagogical agents.

Subba (2011) carried out research investigating the effects of using multimedia technology in teaching geography to grade 7 Bhutanese students. For the experimental group, he used multimedia (video clips, PowerPoint, animations, you-tube, and text) whereas for a controlled group he used traditional method. The finding from his study

indicated that students' learning satisfaction was positive with enhanced learning achievements in the experimental group when compared to the controlled group. Hence, the researcher has concluded that multimedia technology-aided teaching is more effective than traditional teaching in achieving positive learning satisfaction and enhancing the learning achievement of the student.

Seth (2009) carried out research on instructional media -a tool for ensuring quality teaching and learning for students in the junior high school in Ghana. 72.5% of 80 teacher respondents said they have used appropriate instructional media in classroom teaching. The finding showed 95% of the respondents agreed that the use of instructional media is important when the students are young as it makes the classroom environment interesting, enjoyable, and attractive. It was also found that learning was much faster and easier, and made a positive impact on students' participation in-class activities and performance than in traditional classroom. Hence, the researcher concluded that the lessons with instructional multimedia encourages participation and motivation among the students resulting in positive learning achievement.

Urbanova and Ctrnactova (2009) carried out research to find out the effectiveness of PowerPoint Presentation as a Component of Science Education. The aim of the study was to determine the effectiveness, as well as the benefits and drawbacks, of using ICT, namely PowerPoint presentations, in various aspects of the teaching process in the field of natural sciences. The study concluded that few students lose attentiveness but the majority of the students displayed an increase of attentiveness, interest in learning, positive influence in activities, and above all teaching is more attractive for the students. The result also presented, teaching with PowerPoint presentations saves time, is better organized, more illustrative, and more diversified.

Weiss, Kramarski, and Talis (2006) carried out research on the effects of multimedia environments on kindergarten children's mathematical achievements and style of learning. The research aimed at two major areas 1) to examine the effects of

learning mathematics with multimedia embedded in different styles of learning (cooperative learning versus individual learning) in kindergarten on students' mathematical achievements; 2) to examine students' preference for style of learning with computers in kindergarten. A total of 116 students (girls and boys) who were studying in kindergarten took part as research participants. The findings showed that the experimental group significantly outdid the controlled group in mathematical achievement.

The studies undertaken by different researchers around the world on the use of multimedia to enhance the learning achievement and satisfaction of the students were successful. Nevertheless, the studies have also mentioned some limitations and suggestions to focus on some areas of improvement in the studies which will help to create awareness among future researchers. They also presented the result of their studies in different grades which were the basis of the studies. Finally, it is clear that the usage of multimedia technology has a significant impact on students' achievement and satisfaction. The aforementioned studies and research show that using multimedia in the classroom is an effective teaching strategy.

2.9 CONCLUSION

Learning theories like Cognitive Theory of Multimedia Learning, Multiple Constructivism Theory, and Multiple Intelligence Theory support the use of multimedia technology (PPT and short videos) in the mathematics classroom. Multimedia (PPT and short videos) present both aural and visual aspects and provide reach resources for learners to construct knowledge of their own and learn through employing multiple intelligence. Many researchers have studied to find out the effectiveness of multimedia (PPT and short videos) in various subjects including mathematics across different grade and age levels. All the related studies mentioned above revealed that the use of multimedia (PPT and short videos) had a positive relation with reduced mathematical anxiety and positive learning achievement and satisfaction.

From all the information and related studies explored by the researcher, it can be concluded that multimedia can be used as one alternative teaching technique to teach mathematics to students. Hence, it is the sole responsibility of a teacher to guide students' interest towards building a conducive environment while planning to use multimedia as an alternative teaching tool. The learning activities should also be driven towards achieving the objectives that will have great potential in enhancing learning achievement and satisfaction of mathematics.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter presents the general procedure that will be adopted to carry out the study. It will describe the research design, the participants of the study, the research instruments used for collecting data, the details of how instruments were validated and how reliability of the instruments were tested, and finally the description of data analysis procedure.

3.1 RESEARCH DESIGN

In this study, the researcher used mixed methodology incorporating both aspects of qualitative and quantitative approaches to examine the grade 5 Bhutanese students' learning achievement and satisfaction on using multimedia technology to teach mathematics (fractions). According to Halcomb and Hickman (2015), mixed method of research considers the use of both quantitative data and qualitative data in a single study. Mixed methods research is a blend of components of qualitative and quantitative research methods for the purpose of in-depth knowledge and substantiation (Johnson, Onwuegbuzie, & Turner, 2007). Mixed methodology, according to Almalki (2016), is a sort of research in which researchers use parts of both qualitative and quantitative research methodologies to acquire in-depth data. Cameron and Sankaran (2015) state that mixed methods research means the study that comprises collection of data, analysis of the collected data, and interpretation of both the quantitative and qualitative information in one or many studies that analyze the same basic phenomenon.

The pretest-posttest was 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 3.1 shown below describes the research design of the study.

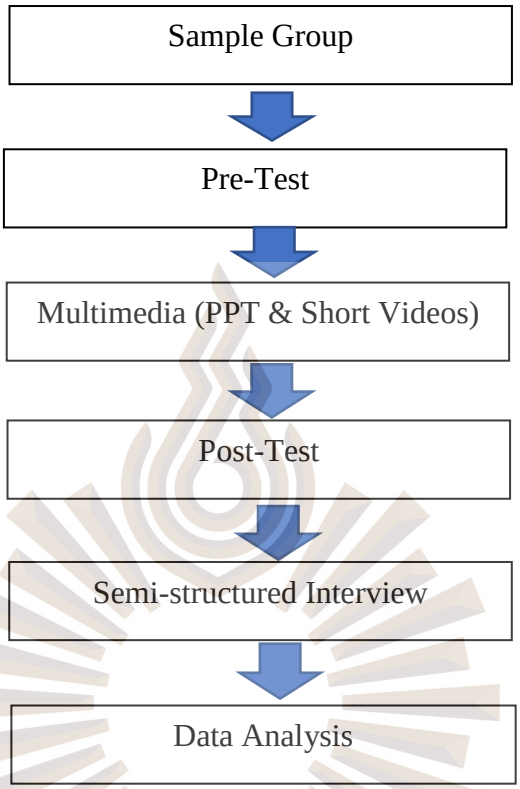

Figure 3.1 Research design of the study

3.2 POPULATION AND SAMPLE OF THE STUDY

3.2.1 Population

The study's target population was Grade 5 students studying mathematics in one of Bhutan's schools. The school is in the Bumthang district, which is in Bhutan's central region. The population was between the ages of 11 and 13.

3.2.2 Sample/Research participants

For the 2021 Academic Year, the research school only had one section of Grade 5 students. Therefore, the researcher used entire students of grade 5 as a

research participant. The sample/research participants comprised 32 grade 5 Bhutanese students for the study. Table 3.1 provides the detail of the research participants in terms of gender and age.

Table 3.1 Demographic profile of the research participants

Genders	Male	Female	Total
Number of the students	14	18	32
Age groups	11-13	11-13	

3.3 RESEARCH INSTRUMENTS

Research Instruments are measurement tools planned and prepared to obtain specific and pertinent data on a given research subject. The research instruments are the tools for data collection that guides the researcher to get relevant and authentic data from the data collection process (Annum, 2018). This study considered three instruments for the purpose of data collection. These included lesson plans, pretest and posttest (learning achievement tests), and a semi-structured interview.

3.3.1 Instructional Instrument

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" (see Appendix F for example of Lesson Plan). The topic was further divided into 4 sub-topics and was taught over four weeks. Lesson plan were planned infusing all the component of the lesson plan starting from greeting, followed by lesson objectives, looking for previous knowledge, introduction, lesson input, activities, monitoring, follow up, and finally lesson closure. The PPT and Video clips were used at different stage of lesson as per the need of the topic and to make lesson interactive and effective. In total eight lessons were taught in which two sessions every

week were taken for the period of a month. All the lessons were planned incorporating multimedia (PPT & short video clips) for teaching the research participants.

3.3.2 Quantitative Data Collection Instrument

Achievement Test

The learning achievement test was conducted before and after the intervention to compare the learning achievement of the students. It consisted of pretest and posttest. 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 (see Appendix B for Achievement Test Question).

3.3.3 Qualitative Instruments

Semi-Structured Interview

A semi-structured interview is very useful for the purpose of an in-depth understanding of a phenomenon of interest. According to Lochmiller and Lester (2017), a semi-structured interview provides the researchers with more space and time to conduct the interview in a more relaxed and informal manner as it allows unanticipated understanding to arise. Hence, to explore students' satisfaction towards the use of multimedia in learning mathematics, in groups of three members each, a face-to-face interview after the intervention was conducted. The interview consisted of 5 questions that the researcher has framed (see Appendix D for Semi-Structured

Question). 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 in English. The data were then analyzed using a thematic analysis technique.

3.4 VALIDITY AND RELIABILITY OF RESEARCH STUDY

3.4.1 Content Validity

Validity is defined as a test of how well the designed instrument measures the particular concept that is intended to be measured (Bajpai, S., & Bajpai, R., 2014). The validity of research instruments (lesson plans, test items, and semi-structured interview questions) were validated by 3 experts, a professor from Rangsit University, Thailand, and two experienced mathematics teachers from Bhutan (see Appendix H for Expertise Details). The validity of the instruments was done using the Item Objective Congruence Index (IOC). The instrument's IOC was calculated to determine whether or not the items were aligned with the learning objectives. The result of the IOC index ranges from -1 to +1 as described below:

If the item receives a rating of 1, it obviously meets the stated objectives.
0, means the item is uncertain, not sure if it meets the objectives or not.
-1, tell us that the item clearly does not match the objective.

IOC in this study was calculated by using the formula: IOC $\sum = \frac{r}{n}$, where 'r' is the score of individual expert's ratings and 'n' stands for the total number of experts. The value of test items between 0.67 and 1.00 was considered accurate and acceptable whereas a value below 0.67 indicates that the items need to be rephrased as per the expert's suggestions and feedbacks.

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 (see Appendix G for Validity Report by Experts for Lesson Plan and Appendix C for Validity Report by Experts for Learning Achievement Test). The semi-structured questions were rated 0.934 which was above 0.67 (See Appendix E for Validity Report by Experts).

3.4.2 Reliability

Reliability is a degree to which a given instrument in a study such as a questionnaire, achievement test item, observation checklist, etc. generates the same outcome on repeated trials (Bolarinwa, 2015). Hobbs (2016) says without self-assurance that the measure you have selected is reliable, it is hard to determine whether variances in performance of pre-intervention and post-intervention are actually due to the intervention provided and not an artifact of the tool. 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) which is considered standard formula was used to check the reliability coefficient of the learning outcome of the test. The KR-20 coefficient obtained was 0.731 (see Appendix J for the Reliability Test Report) which was greater than 0.70. Thus, the coefficient of 0.731 revealed that the test items were reliable.

3.5 DATA COLLECTION STEPS

3.5.1 Ethical Consideration

3.5.1.1 Approval

The researcher sought approval from the research and development institute, Rangsit University. After that letter of approval from the Ministry of Education in Bhutan, Chief District Education Officer (CDEO), Principal, Head of Department of Humanities, and concerned subject teacher of the research school was

formally received before the actual data collection began (see Appendix A for the Letter of Approval). 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 (see Appendix H for a letter of consent).

3.5.1.2 Anonymity of the Participants

The participants' details, opinions, and interview records were kept confidential and anonymous throughout the study. The participants were not recognized in the study by name; rather serial numbers were used as an alternative to ensure confidentiality (Example: Student1, Student2, Student3). This was also informed to the students before the study.

3.5.2 Pretest

The researcher administered pretest for research participants (32 students) mainly to ascertain the current knowledge level of students about the research topic. To make it reliable the researcher gave a week long time to the students to prepare for the test. The pretest question consists of 5 marks multiple-choice questions, 5 marks true or false question, and 10 marks short answer questions. They were given 1 hour to complete the test.

3.5.3 Intervention

The researcher designed four lesson plans of 90 minutes (1 lesson plan = 2 sessions) each, to teach mathematics to research participants on the topic "Fractions". Lesson plan were planned infusing all the component of the lesson plan. The PPT and Video clips were used at different stage of lesson as per the need of the topic and to make lesson interactive and effective. The classes were completed in eight sessions over four weeks, with two sessions per week. All the lessons were planned

incorporating multimedia (PPT & short video clips) for teaching the research participants.

3.5.4 Posttest

Posttest was administered after the completion intervention with the research participant using the same test paper that was used for pretest for a duration of 1 hour. It was conducted to check the learning achievement of research participant after using multimedia technology in teaching mathematics to grade 5 Bhutanese students.

3.5.5 Semi-Structured Interview

To know the student's satisfaction on the use of multimedia technology in teaching-learning mathematics a semi-structured interview was conducted with the research participants. Owing to the convenient of research participants, a face-to-face interview was conducted in groups of three members each. 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 in English.

3.6 DATA ANALYSIS

The data analysis was done in two broad areas:

Test score analysis to examine the effects of using multimedia technology to improve learning achievement in mathematics (fraction).

Thematic analysis of interviews to find out the student's satisfaction toward the use of multimedia technology in mathematics (fraction).

3.6.1 Analysis for learning achievement

To determine the level of students' learning achievement, pretest and posttest were conducted before and after the intervention of multimedia technology in teaching mathematics. Marks scored in pretest and posttest were analyzed using paired samples T-Test by with the help of a suitable software computer program. The comparison was carried out based on mean, standard deviation, and significant value.

3.6.2 Analysis for learning satisfaction

Since it was mixed method research, 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 Semi-structured interview was analyzed after developing themes and patterns through coding using thematic analysis technique.

CHAPTER 4

RESEARCH RESULTS

This chapter discusses the key findings of the research carried out on the topic 'The Application of Multimedia Technology in teaching and learning Mathematics of Grade 5 Bhutanese students. The data were analyzed in two parts. The first set of data analyzed was data gathered through Pretest and Posttest which responded to Research Question One. The second set of data collected from Semi-Structured Interview was analyzed through thematic analysis of which findings were used to respond to Research Question Two.

The findings from the data are presented as follows:

4.1 Result of Learning Achievement Test Scores

4.2 Result of Semi-structured Interview Scripts

4.1 RESULT OF QUANTITATIVE DATA

The first objective of this research was to investigate the improvement of students' learning achievement in Grade 5 students after using multimedia technology in teaching mathematics. The pretest and posttest comprising 13 questions were administered with 32 Grade 5 Bhutanese students before and after the intervention was implemented. The comparison of pretest and posttest scores of the research participants was completed with the help of paired sample t-test to determine the effectiveness of using multimedia technology in a Bhutanese classroom. The comparisons were made based on the mean, standard deviation, and significance value (P-Value). The comparison was also done 'within the group' by comparing the pretest scores with the posttest scores of the sample group.

4.1.1 Data Analysis of the Pretest and Posttest

As shown in Table 4.1 below, the data obtained from the pretest and posttest scores were analyzed to compare the learning achievements of Grade 5 Bhutanese students before and after the intervention. It shows the results of the descriptive statistical analysis for the achievement test scores of the sample group. The pretest and posttest mean scores were 8.81 and 14.72, respectively. It is evident from the results presented in the table that the posttest mean score ($\bar{x}$ =14.72) of the group was higher than that of the pretest mean score ($\bar{x}$ =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 displays 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 as shown in table 4.1.

Table 4.1 The comparison of the sample group's pretest and posttest results.

Group	Pretest		Posttest		Mean Difference	T	P – value
Sample Group	$\bar{x}$	SD	$\bar{x}$	SD	14.72 -8.81 = 5.91	- 11.28	.001
	8.81	3.23	14.72	2.43			

Significance level (p): < 0.05- significant

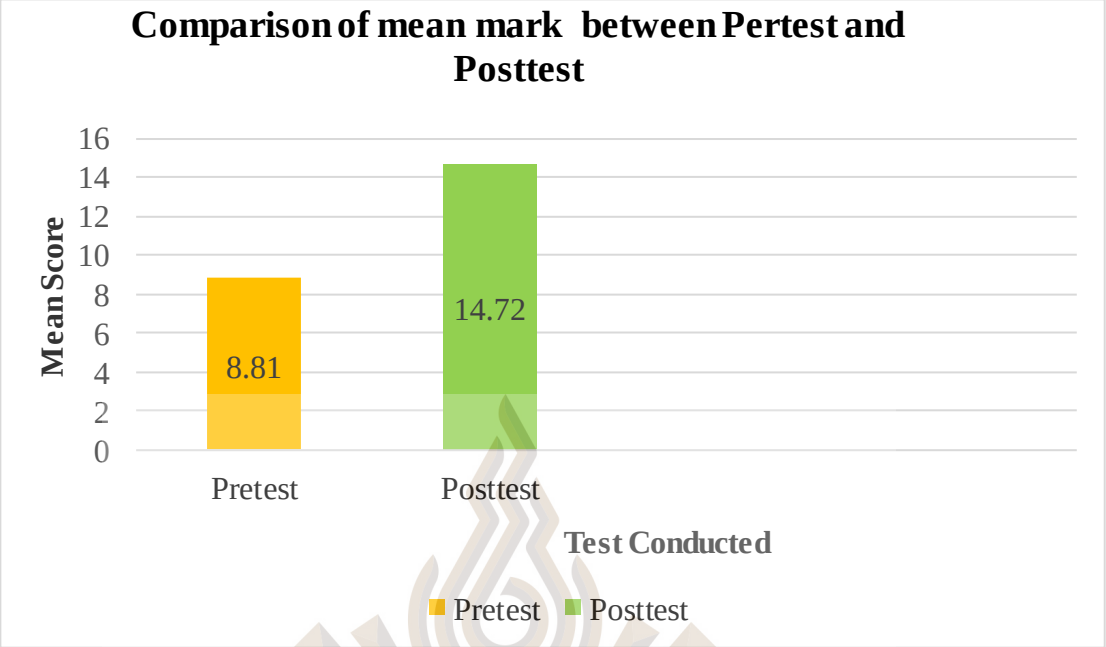

Figure 4.1 Pretest and Posttest Mean Comparison

The mean scores of the posttest are comparatively higher than the pretest, which clearly shows that before using intervention their learning achievement was low compared to the learning achievement after the intervention. The mean of the posttest is greater than that of the pretest as shown in figure 4.1 above. All these scores in comparison confirmed the effectiveness of using Multimedia Technology to improve the learning achievement of Grade 5 Bhutanese students in mathematics. Therefore, providing a positive response to the first research question and ascertaining the research objective one and hypothesis one accordingly.

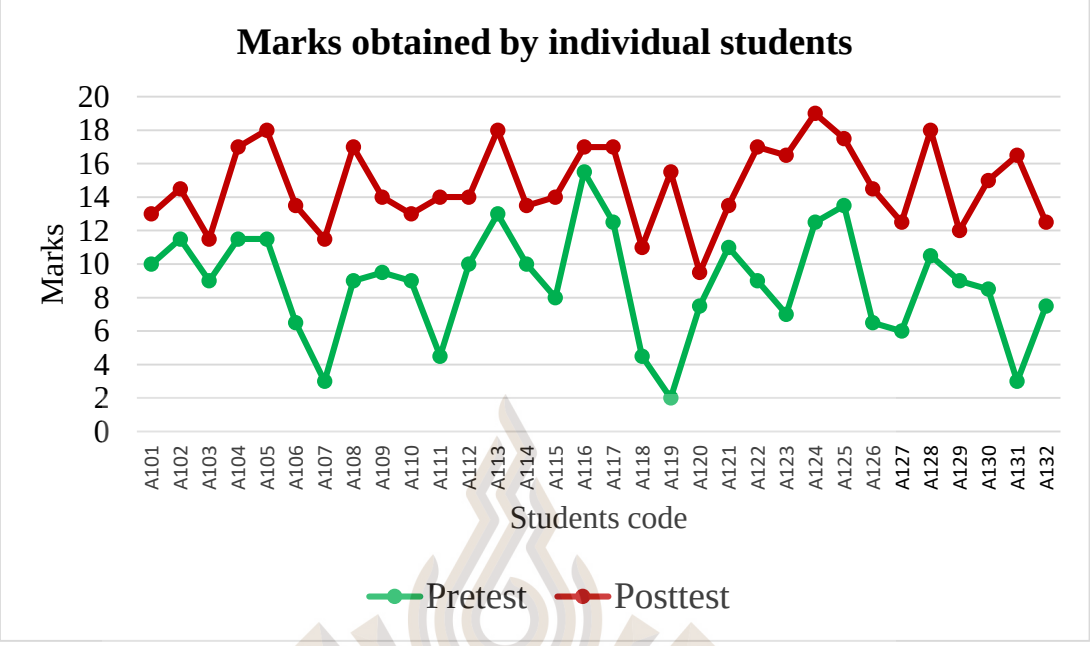

Figure 4.2 Comparative graphical representation of individual student learning achievement scores in Pretest – Posttest

The green line and the red line in figure 4.2 represent the individual student's learning achievement scores in the pretest and posttest respectively. All research participants 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 Multimedia Technology is therefore visible. 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. 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.

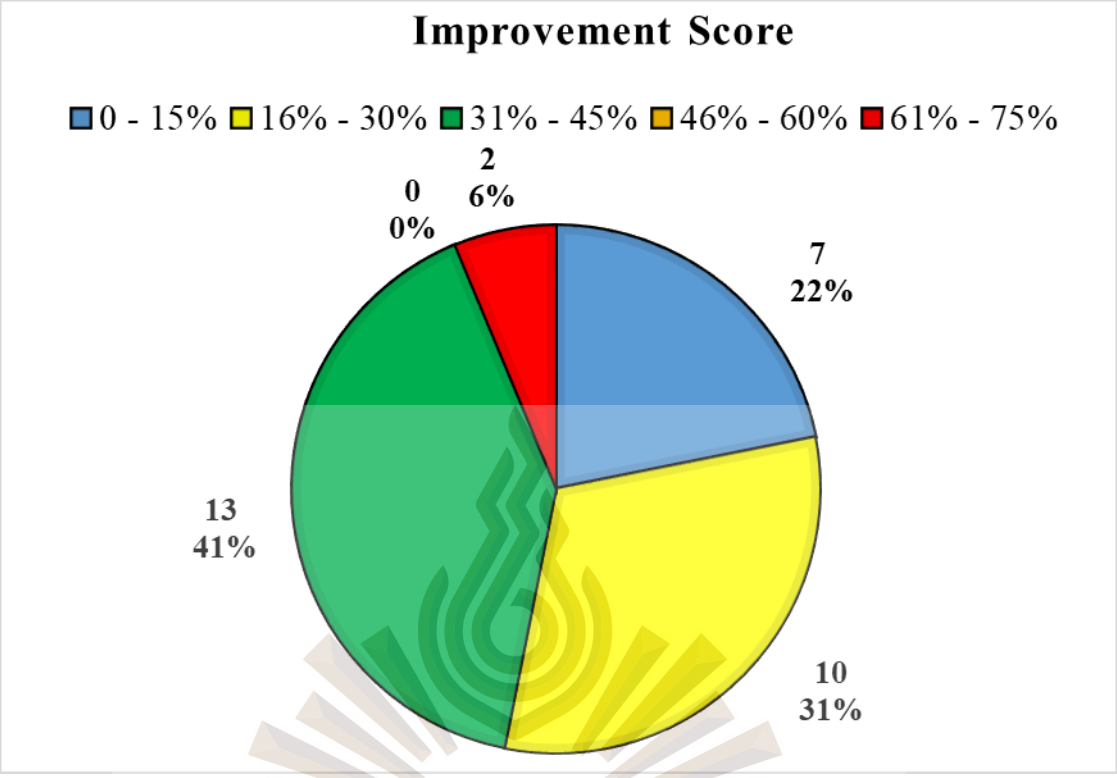

Figure 4.3 Number of students in each score difference

The pie chart illustrates the number of students in score differences between the scores of pretests and the posttest. From the total of 32 students, 7 students which equal 22% secured 0-15% more in the posttest than in the pretest which is the minimum increase in posttest comparing to other students. While 2 students out of 32 which equals 6% secured 50%-75% more in the posttest than in the pretest which is the maximum increase in the posttest. Overall, the largest score difference between the pretest and the posttest was 67.5% secured by 2 students and 7.5% increase in posttest secured by one student being the lowest.

Table 4.2 Score difference between Pretest and Posttest.

Student code	pretest score	Posttest Score	Improvement Score
A101	10.0	13.0	3.0
A102	11.5	14.5	3.0
A103	9.0	11.5	2.5

Table 4.2 Score difference between Pretest and Posttest. (Cont.)

Student code	pretest score	Posttest Score	Improvement Score
A104	11.5	17.0	5.5
A105	11.5	18.0	6.5
A106	6.5	13.5	7.0
A107	3.0	11.5	8.5
A108	9.0	17.0	8.0
A109	9.5	14.0	4.5
A110	9.0	13.0	4.0
A111	4.5	14.0	9.5
A112	10.0	14.0	4.0
A113	13.0	18.0	5.0
A114	10.0	13.5	3.5
A115	8.0	14.0	6.0
A116	15.5	17.0	1.5
A117	12.5	17.0	4.5
A118	4.5	11.0	6.5
A119	2.0	15.5	13.5
A120	7.5	9.5	2.0
A121	11.0	13.5	2.5
A122	9.0	17.0	8.0
A123	7.0	16.5	9.5
A124	12.5	19.0	6.5
A125	13.5	17.5	4.0
A126	6.5	14.5	8.0
A127	6.0	12.5	6.5
A128	10.5	18.0	7.5
A129	9.0	12.0	3.0
A130	8.5	15.0	6.5
A131	3.0	16.5	13.5
A132	7.5	12.5	5.0

Table 4.2 is presented not only to supplement the descriptive statistical analysis results but also to provide a concise understanding of each student's increased scores in posttest than pretest. The highest increase was made by student no. A119 and A131 by scoring 13.5 marks higher in the posttest than the pretest. On the other hand, student no. A116 made the lowest increase by scoring 1.5 marks higher in the posttest than the pretest. All students managed to increase their scores in the posttest from the pretest.

4.2 RESULT OF QUALITATIVE DATA

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 intended to find out whether teaching mathematics using multimedia technology (video & PPT) would increase students' learning satisfaction or not. At the end of the study, all of the students in the sample group were interviewed. Considering time constraint and the research participants' convenience, the researcher carried out the interview in groups of 3 members each. They were given the freedom to form their own groups. To protect the privacy of the research participants, the researcher used the same student code which was used during the pretest and posttest. To share students' opinions on the study, they were allowed to speak in the language that they felt comfortable with. The response of students was recorded and transcribed in English for data analysis. The collected data were read, analyzed, and coded (interpreted) into themes aligned with the research objectives and questions of the research. The data from the students' 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 in using multimedia technology in learning mathematics.

4.2.1 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.

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

> "We enjoyed the lesson. Learning through video and PPT is a good activity because it is colorful and wonderful. We liked the video the most because in the videos we could see the motion clearly which help us to understand the content better. It really was learning with fun.

Also, the lesson was made fun with amazing motion and lights. The contents of the media (videos) like dialogues, rich vocabulary, good pronunciation, and involvement of audio-visual aspects attracted the participants' attention in learning.

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

> "We felt happy and excited to learn using PPT and video clips because it was interesting and fun. We could learn many thing like pronunciation, vocabulary and how to participate from the video"

4.2.2 Desire to Learn

Using multimedia technology in teaching and learning mathematics made learning fun and enjoyable for the students. They shared that they were satisfied, and it 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 using PPT and Video because it is with fun, activities are very interesting and it helped us to understand the concept easily"

"We would like to learn other topics using multimedia technology because it's interesting, we can understand better and retain the information for a longer period. We also get more time to write and learn because the teacher needed less time to write on the chalkboard as everything is there in PPT"

"Learning with the help of multimedia technology helped us in learning many new things apart from what's there in the textbook. We could understand the lesson easily as we can see the clear picture of the concept when taught especially using videos. It would be great if other topics were also taught in the same way"

4.2.3 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. Most of them shared learning mathematics through multimedia helped them to comprehend the concept faster and in an easier manner.

"When we study through video clips and PPT, we understand very easily. The examples from the video clips made us understand the concept faster and better. We could remember for a longer time"

"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"

"We liked learning mathematics through multimedia technology. We could understand better especially when taught with video clips. In video clips, we can see a clear picture of the content and how it works. We also got much more new information from the video clip which is not in our text"

4.2.4 Learning Motivation

Most students during the interview mentioned that they were highly motivated to learn when multimedia was used in learning mathematics.

"Teaching mathematics using multimedia motivated us to like the subject more. We can learn and understand better and keep in our minds for a longer period".

"We could love if other subjects and topics were taught using multimedia because it is easy to understand and we can learn better"

The use of multimedia also 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".

4.2.5 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"

> "Till now most of the time we were taught mathematics with the help of chalk and chalkboard, text, manipulative, and chart. The use of PPT and Video clip while learning mathematics is new to us and it made us learn mathematics with fun. It provided us more time to learn in the classroom because the teacher spends less time writing on the chalkboard as everything is there in PPT and Video. It would be nice if other topics were also taught using PPT and Videos"

The above quotations from students' responses clearly indicates that the students enjoyed the lessons and they had positive opinions towards using multimedia technology (videos & PPT) in the mathematics classroom. With most students sharing positive opinions regarding the use of multimedia technology, it can be concluded that they loved learning mathematics through this strategy. Through the analysis of the interview responses, it is clear that learning mathematics using multimedia (PPT & Video clips) boosted students' interest in learning. Moreover, the activities designed for the lessons were also equally interesting and fun as stated by some students. Similarly, it was observed that students' interest in learning mathematics improved after the introduction of multimedia technology in teaching and learning. Thus, the researcher concluded that the use of multimedia technology (PPT & video) in teaching mathematics has not only improved learning achievement but students also revealed positive learning satisfaction.

CHAPTER 5

CONCLUSION, DISCUSSION, AND RECOMMENDATION

This chapter contains the conclusions to the findings of the study presented in chapter 4. Here, the relevant literatures are reviewed to support the findings of the study. It is followed by discussions of the findings and recommendations for future studies and research to improve the teaching-learning processes in general, and teaching mathematics in particular.

5.1 CONCLUSION

This study was guided by two main questions:

1) Would there be any improvement in grade 5 Bhutanese students' learning achievement in fractions after using multimedia technology?

2) Would grade 5 Bhutanese students exhibit learning satisfaction in learning fractions after using multimedia technology?

The data were collected and analyzed from the learning achievement test (pretest and posttest scores) and semi-structured interview.

5.1.1 The Result of Test Score Analysis

The researcher used the scores of pretest and posttest to respond to the first research questions. The first question of this research was: Would there be any improvement in grade 5 Bhutanese students' learning achievement in fractions after using multimedia technology? To answer this question, pretest and posttest were conducted with the research participants on the same items to find the learning

achievement of the research participants prior to and after the use of multimedia technology (PPT & Video Clip) in teaching fractions to grade 5 Bhutanese students. (See Appendix I for Learning Outcome of the Test)

Paired sample t-test was used for carrying out comparative statistical analysis within the research participants to see the difference in the level of learning achievement between the pretest and the posttest. The mean scores of the pretest and the posttest were 8.81 and 14.72 respectively. The mean difference between the pretest and the posttest was 5.91. The results of the analysis showed that the mean score of the posttest was higher than the mean score of the pretest as shown in Table 4.1 in Chapter 4. The significance value (p) was 0.001 indicating there was a statistically significant increase in the scores of posttests than in pretest of the research participants.

Thus, the study came to the conclusion that there was a significant improvement in the learning achievement of grade 5 Bhutanese students when multimedia was used in teaching and learning mathematics. Accordingly, the first research hypothesis which specified that there would be an improvement in the learning achievement of the students after using multimedia has been proven to be correct.

5.1.2 The Result of the Semi-Structured Interview

Satisfaction or dissatisfaction level had a strong impact on students' achievement in learning. The high level of learning satisfaction in students represents their motivation, attitude, and enthusiasm in learning. Also, it urged them to advance further which usually brought positive improvement and higher learning achievements. Likewise, the second guiding objective of this research was to identify grade 5 Bhutanese students' learning satisfaction on using multimedia technology in teaching and learning mathematics. For this purpose, the researcher incorporated semi-structured interviews to gather qualitative data, and most importantly, to draw answers for the second research question.

The semi-structured interview was conducted involving all the research participants. Due to time constraint and research participants' convenience, the researcher carried out the interview in groups of 3 members each. They were given the freedom to form their own groups. The data collected were analyzed through thematic analysis and it was evident that learners had positive learning satisfaction towards the use of multimedia technology (PPT & Video clip) in learning fractions. The researcher used the six-step process to analyze the responses of the students under five themes namely 1) Interesting and Fun, 2) Desire to Learn, 3) Facilitated Learning Satisfaction, 4) Learning Motivation, and 5) Revolution in Learning. The result revealed that the participants were interested and motivated to learn mathematics when multimedia were used. The use of multimedia in the mathematics classroom attracted the participants' interest and made learning joyful. Participants loved learning with fun and in new ways which were provided when using multimedia technology in teaching and learning. The use of multimedia made the learning easy, which encouraged and inspired them to learn and take part in the classroom activities.

The overall findings also showed that using multimedia for teaching and learning mathematics was a new thing for them and it made a positive impact on their learning. Most of them shared that learning mathematics through multimedia helped them to learn the subject better and they desired to learn other topics through multimedia too. It also helped them to remember and recollect the lessons in a short period. Similarly, they also understood the concept better and could perform well in the subject. Hence, it was proven that the use of multimedia (PPT & Video clip) enhanced the learning achievement of Grade 5 Bhutanese students in learning mathematics.

5.2 DISCUSSION

As mentioned above, the study disclosed two major findings. The first finding was that the use of multimedia technology (PPT & Video Clip) was effective in teaching and learning mathematics for Grade 5 Bhutanese Students. The second

finding was that the Grade 5 Bhutanese Students exhibited positive learning satisfaction towards the use of multimedia technology (PPT & Video Clip). The following discussion intends to present the findings in detail and explain how they answered the research questions proposed in this study.

5.2.1 Students' Learning Achievement

The study's findings showed that the use of multimedia technology to teach and learn mathematics was effective. The results revealed that with a mean difference of 5.91, the posttest mean scores ($\bar{x}$ 14.72) were significantly higher than the pretest mean scores ($\bar{x}$ 8.81). 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.

All the students showed increased scores in the posttest in comparison to the pretest scores, including those low achievers in the class. Upon interview with these students, they responded that the use of multimedia technology helped them to understand the content better. This finding is parallel to the research findings of Hasan, Bhatti, and GebreYohannes (2016) on the impact of multimedia in teaching mathematics. According to their findings, multimedia-based teaching and learning processes significantly improved students' performance. It was also found out that the teaching and learning carried out in this way was more systematic and comprehensible.

The usage of multimedia technology in the classroom has a good influence on students' academic performance, according to this study. The finding was parallel to studies conducted by Eyyam and Yaratan (2014). Their findings showed that most of the students favored being in a class where educational technology was used as the use of multimedia technology has positively affected students' achievement and

satisfaction. Additionally, Weiss, Kramarski, and Talis (2006) revealed that the use multimedia in kindergarten improved children's mathematics achievement and learning style significantly.

Further, improvement in posttest scores could be attributed to the use of PPT and Videos in the mathematics classroom as it made the classroom atmosphere conducive and fun resulting in positive learning. This is parallel to the study carried out by Naidoo and Hajaree (2021) where he explored 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. The usage of technology-based learning was also found to be valued by students. This is similar to the study conducted by Kolak and Ozan (2012). The finding showed that students' learning achievement and attitude were positively affected by the use of multimedia. The study concluded that the students who used the software improved their learning outcomes significantly.

5.2.2 Students' 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 learning, 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 showed that all the students found the lessons interesting and joyful. The finding was parallel to the study carried out by Seth (2009). His research result showed that 95% of the respondents agreed that the use of instructional media is important when the students are young as it makes the classroom environment interesting, enjoyable, and attractive. It was also reported that learning

was much faster and easier. Further, it not only showed a positive impact on student's participation during the class activities, but they also performed much better when multimedia technique was used. This was also in line with a study carried out by Urbanova and Ctrnactova (2009) about the Efficiency of PowerPoint Presentation as a Component of Science Education. The result of the study showed that when PowerPoint presentation was used, students displayed an increase of attentiveness, interest in learning, positive influence in activities, and above all teaching is more attractive for the students. The result also presented teaching with PowerPoint presentations saves time, is better organized, more illustrative, and more diversified.

They were also highly motivated and indicated positive learning satisfaction for the use of multimedia technology in teaching and learning mathematics, according to the interview result. This result was in line with the study carried out by Alkhasawneh (2016) to investigate the effects of multimedia–aided teaching on kindergarten children's mathematical achievement and satisfaction. 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' achievement. The above statement is also supported by a study carried out by Subba (2011). The finding from his study indicated that students' learning satisfaction was positive with enhanced learning achievements in the experimental group when compared to the controlled group.

Furthermore, when multimedia technology was used, it helped the students to understand and recall the text better. The use of audio and visuals helped students to get a clear picture of the content in a simple way. This learning is supported by Mayer and Moreno (2003), the principle of Cognitive Learning Theory of Multimedia learning which believes that the learning is meaningful when learners interact with audio-visual material than from aural alone. The use of multimedia also provided students to construct their own knowledge considering the theory of constructivism. Bada (2015) states that constructivism is a theory which emphasizes that individual learner will try to make use of all the information that they perceive and construct their own meaning from that information. Moreover, the use of multimedia technology

provided students with multiple ways to learn mathematics according to their learning style which is supported by the theory of multiple intelligence.

The possible reasons for such findings could be due to the conducive and friendly atmosphere created by the use of multimedia technology and simultaneously active involvement of the learners in the learning activities. The other possible reason for exhibiting positive learning satisfaction towards the use of multimedia technology could be due to the use of relevant and reliable PPT and video clips during the lesson. The students were found very curious while doing the activities, actively involved, and motivated throughout the learning process. Thus, with all the positive opinions expressed by almost all the participants, the researcher concluded that multimedia technology was very effective in teaching and learning mathematics to Grade 5 Bhutanese Students.

5.3 RECOMMENDATIONS

5.3.1 Recommendation for Practice

1) Teaching using multimedia technology made a greater positive impact on students' learning achievement. The results from this study revealed that the learning achievement of the posttest was higher than that of the pretest. Therefore, the use of multimedia technology in daily classroom teaching is highly recommended.

2) Multimedia technology can be highly useful and effective if teachers carefully select and plan lessons as per the needs of the learners.

3) Teachers may incorporate the use of multimedia technology in teaching other topics in mathematics to validate if using media technology has the same efficacies as teaching fractions.

4) All Bhutanese teachers may also try to use multimedia technology in teaching other subjects like Social Studies, Dzongkha, English, and Science to make learning effective and improve students' overall learning achievements.

5.3.2 Recommendation for Future Study

1) To carry out further research in this field, the researcher would like to recommend the future researchers as follows:

2) The study was limited to a section of 32 Grade 5 Bhutanese Students. Similar studies could be conducted with different grade levels, larger sample sizes, and longer duration to strengthen the findings.

3) A similar study can be also be carried out in other subjects like Science, English, Dzongkha, and Social Studies.

4) Further researches using multimedia technology could be carried out to explore the influence of variables like gender, age, level of study, and mode of study. It could be used in different learning situations to further expand the knowledge of students' learning and students' academic achievement.

5) The study focused on just two types of multimedia technology (PPT & Video clip), other types could be explored for more effective learning.

Lastly, using multimedia technology is an effective teaching method that is very much required in today's classrooms, especially in teaching and learning mathematics (fractions). If schools implement multimedia technology, learners will 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 best alternative approach in teaching to improve students' learning achievement and satisfaction.

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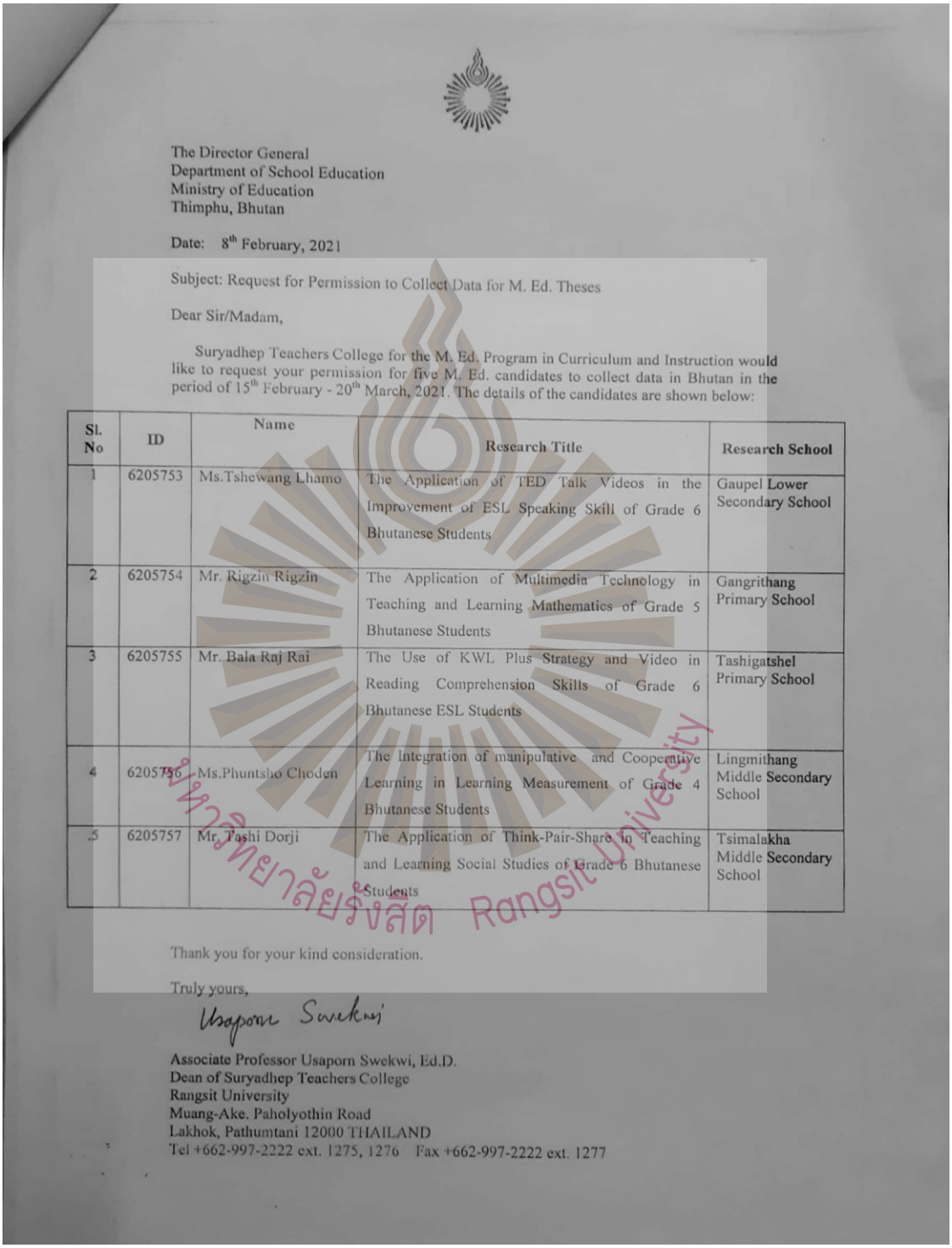
APPENDICES

APPENDIX A

LETTER OF APPROVAL



The Director General
Department of School Education
Ministry of Education
Thimphu, Bhutan

Date: 8th February, 2021

Subject: Request for Permission to Collect Data for M. Ed. Theses

Dear Sir/Madam,

Suryadhep Teachers College for the M. Ed. Program in Curriculum and Instruction would like to request your permission for five M. Ed. candidates to collect data in Bhutan in the period of 15th February - 20th March, 2021. The details of the candidates are shown below:

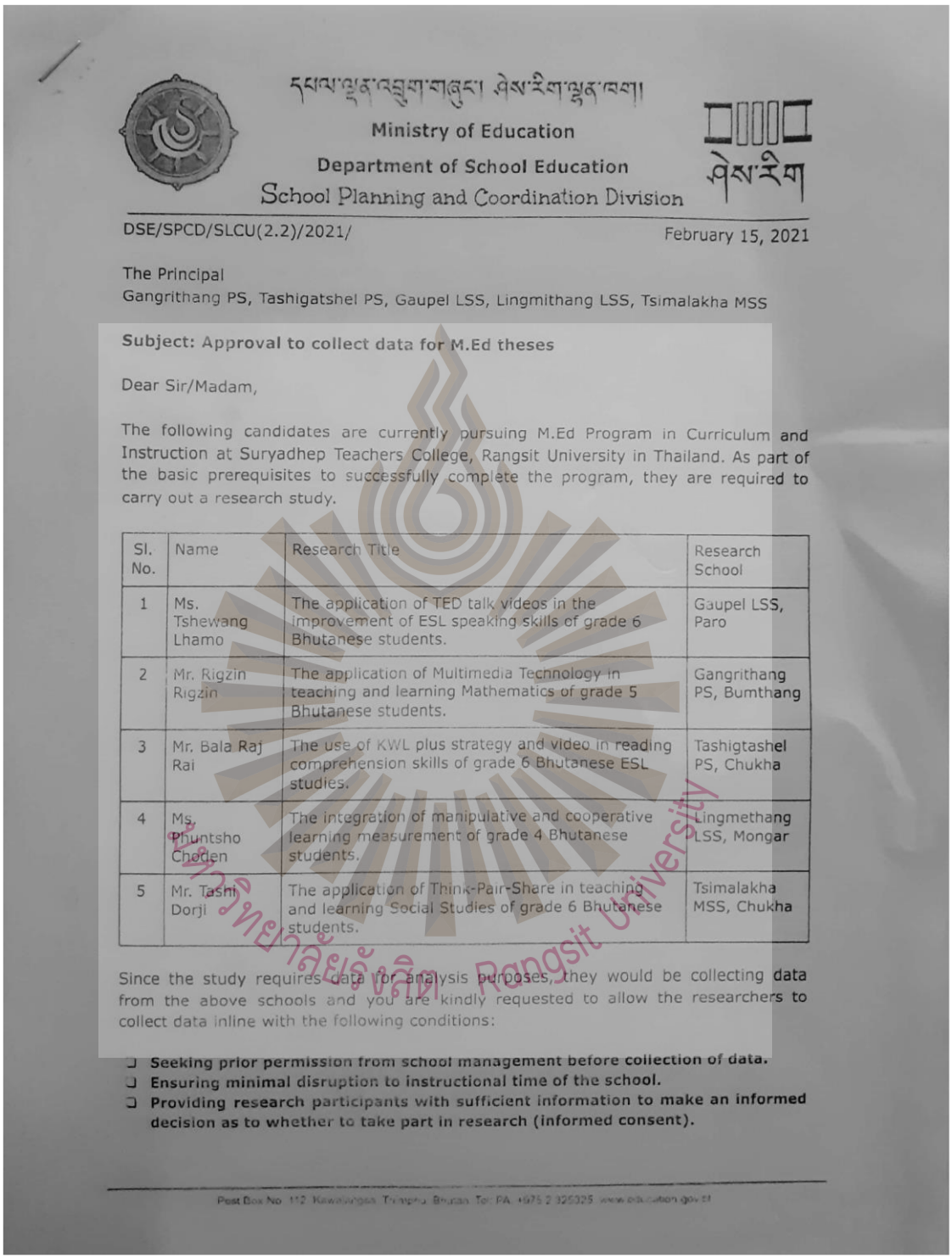
Sl. No	ID	Name	Research Title	Research School
1	6205753	Ms.Tshewang Lhamo	The Application of TED Talk Videos in the Improvement of ESL Speaking Skill of Grade 6 Bhutanese Students	Gaupel Lower Secondary School
2	6205754	Mr. Rigzin Rigzin	The Application of Multimedia Technology in Teaching and Learning Mathematics of Grade 5 Bhutanese Students	Gangrithang Primary School
3	6205755	Mr. Bala Raj Rai	The Use of KWL Plus Strategy and Video in Reading Comprehension Skills of Grade 6 Bhutanese ESL Students	Tashigatshel Primary School
4	6205756	Ms.Phuntsho Choden	The Integration of manipulative and Cooperative Learning in Learning Measurement of Grade 4 Bhutanese Students	Lingmithang Middle Secondary School
5	6205757	Mr. Tashi Dorji	The Application of Think-Pair-Share in Teaching and Learning Social Studies of Grade 6 Bhutanese Students	Tsimalakha Middle Secondary School

Thank you for your kind consideration.

Truly yours,

Usaporn Swekwi

Associate Professor Usaporn Swekwi, Ed.D.
Dean of Suryadhep Teachers College
Rangsit University
Muang-Ake. Paholyothin Road
Lakhok, Pathumtani 12000 THAILAND
Tel +662-997-2222 ext. 1275, 1276 Fax +662-997-2222 ext. 1277



དཔལ་ལྡན་འབྲུག་གཞུང་། ཤེས་རིག་ལྷན་ཐག།

Ministry of Education

Department of School Education

School Planning and Coordination Division

ཤེས་རིག

DSE/SPCD/SLCU(2.2)/2021/ February 15, 2021

The Principal

Gangrithang PS, Tashigatshel PS, Gaupel LSS, Lingmithang LSS, Tsimalakha MSS

Subject: Approval to collect data for M.Ed theses

Dear Sir/Madam,

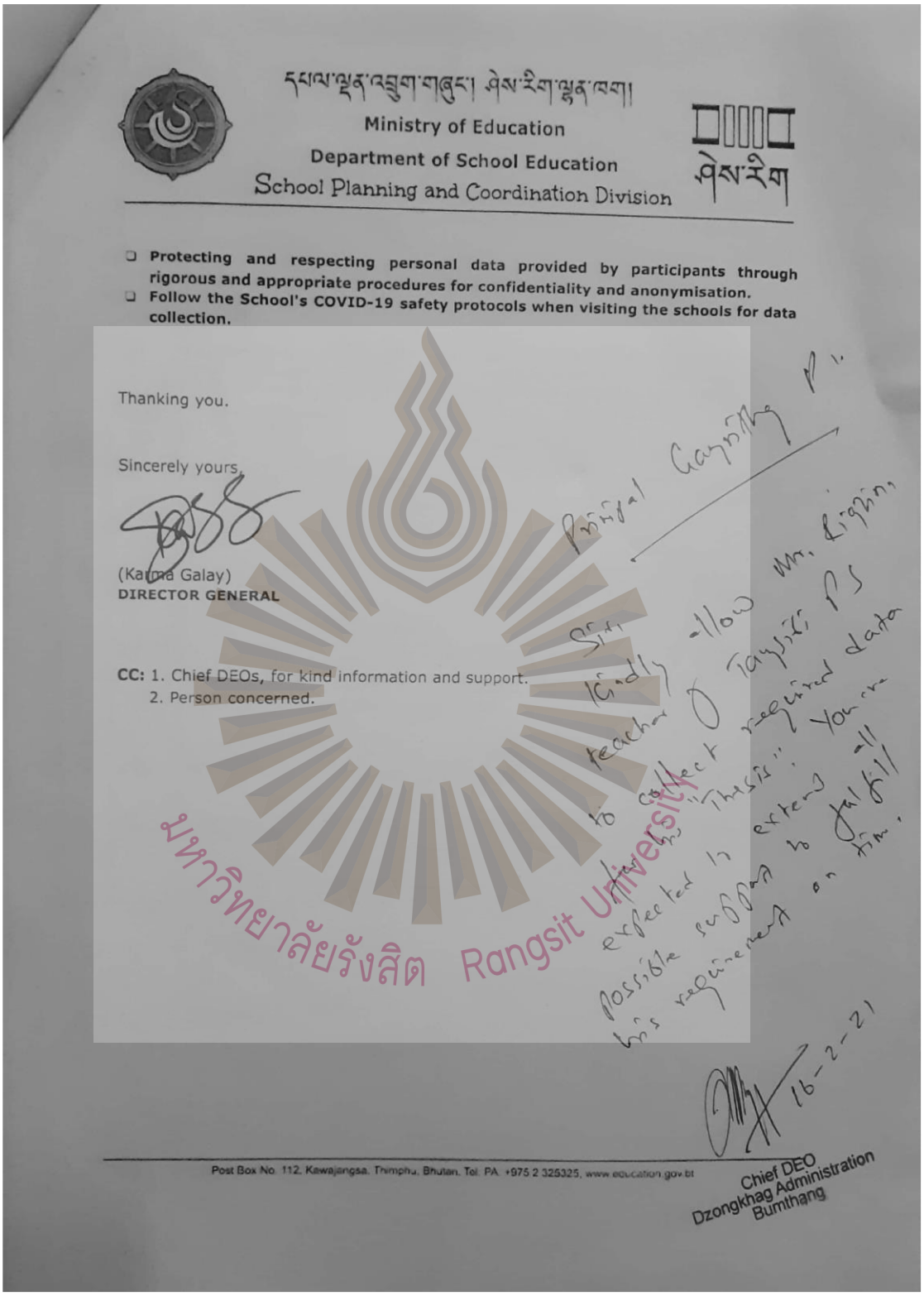
The following candidates are currently pursuing M.Ed Program in Curriculum and Instruction at Suryadhep Teachers College, Rangsit University in Thailand. As part of the basic prerequisites to successfully complete the program, they are required to carry out a research study.

Sl. No.	Name	Research Title	Research School
1	Ms. Tshewang Lhamo	The application of TED talk videos in the improvement of ESL speaking skills of grade 6 Bhutanese students.	Gaupel LSS, Paro
2	Mr. Rigzin Rigzin	The application of Multimedia Technology in teaching and learning Mathematics of grade 5 Bhutanese students.	Gangrithang PS, Bumthang
3	Mr. Bala Raj Rai	The use of KWL plus strategy and video in reading comprehension skills of grade 6 Bhutanese ESL studies.	Tashigtashel PS, Chukha
4	Ms. Phuntsho Choden	The integration of manipulative and cooperative learning measurement of grade 4 Bhutanese students.	Lingmethang LSS, Mongar
5	Mr. Tashi Dorji	The application of Think-Pair-Share in teaching and learning Social Studies of grade 6 Bhutanese students.	Tsimalakha MSS, Chukha

Since the study requires data for analysis purposes, they would be collecting data from the above schools and you are kindly requested to allow the researchers to collect data inline with the following conditions:

- **Seeking prior permission from school management before collection of data.**
- **Ensuring minimal disruption to instructional time of the school.**
- **Providing research participants with sufficient information to make an informed decision as to whether to take part in research (informed consent).**

Post Box No. 112, Kawajangsa, Thimphu, Bhutan. Tel: PA: +975 2 325325 www.education.gov.bt



ཉམས་སྲོན་འཛུགས་གཞུང་། ཤེས་རིག་སྨན་བག།
Ministry of Education
Department of School Education
School Planning and Coordination Division
ཤེས་རིག

- Protecting and respecting personal data provided by participants through rigorous and appropriate procedures for confidentiality and anonymisation.
- Follow the School's COVID-19 safety protocols when visiting the schools for data collection.

Thanking you.

Sincerely yours,

(Karma Galay)
DIRECTOR GENERAL

CC: 1. Chief DEOs, for kind information and support.
2. Person concerned.

Post Box No. 112, Kawajangsa, Thimphu, Bhutan. Tel: PA: +975 2 325325, www.education.gov.bt

Chief DEO
Dzongkhag Administration
Bumthang

ROYAL GOVERNMENT OF BHUTAN

GANGRITHANG PRIMARY SCHOOL

DZONGKHAG ADMINISTRATION

BUMTHANG

Ref: JKD/GPS/DEO-01/2021/ ๙๑๑

19th March, 2021

The Dean,
Faculty of Education
Rangsit University
Thailand

Subject: Completion of Data Collection for M.Ed Thesis

Sir/Madam,

The administration of Gangrithang Primary School is pleased to inform you that Mr. Rigzin who is currently undergoing M.Ed Program in Curriculum and Instruction at Suryadhep Teachers College in Rangsit University, Thailand has successfully completed his data collection in this school. He joined the school for data collection from 15th February, 2021 and completed his data collection on 18th March, 2021.

Thanking you

Sincerely

PRINCIPAL
(Dechen Lodey)
Gangrithang Primary School
Choekhor : Bumthang

GANGRITHANG PRIMARY SCHOOL
Date.....
CHOEKHOR : BUMTHANG

APPENDIX B

LEARNING ACHIEVEMENT TEST QUESTIONS

Questions for Learning Achievement Test

Class: 5

Subject: Mathematics

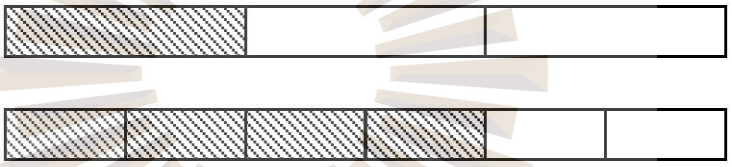
Topic: Fractions Subject:

Total: 20 marks

Part A

Direction: Each statement is followed by four possible answer. Choose the most correct answer and write it in the space provided. (1 x 5= 5 marks)

1) What fraction comparison do the following pictures show?



A $\frac{1}{3} < \frac{4}{6}$

B $\frac{1}{3} > \frac{4}{6}$

C $\frac{4}{6} < \frac{1}{3}$

D $\frac{4}{6} = \frac{1}{3}$

Ans: ……

2) All of the following shows the same fraction, EXCEPT:

A. 

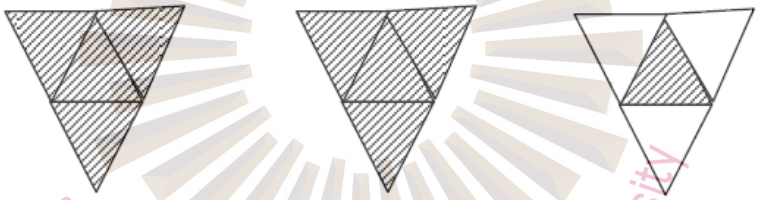
B 

C 

D 

Ans: ……

3) The shaded portions of the diagram given below represent



A $2\frac{3}{4}$

B $2\frac{1}{4}$

C $2\frac{3}{5}$

D $2\frac{1}{5}$.

Ans: ……..

4) The missing value in $\frac{8}{10} = \frac{80}{\quad}$ is

A 25.

B 50.

C 75.

D 100.

Ans: ……

5) If 8 girls share 3 cakes, how much cake will each get?

A $\frac{1}{8}$

B $\frac{2}{8}$

C $\frac{3}{8}$

D $\frac{4}{8}$

Ans: ……

Part B

Direction: Write **True** if statement is correct and **False** if the statement is incorrect in the space provided against the statement. (1 x 5= 5 marks)

Sl. No	**Statement**	**True/False**
1	$\frac{5}{6}$ is greater than $\frac{1}{3}$	
2	1 whole = $\frac{6}{8}$	
3	The mixed fraction of $\frac{17}{13}$ is $2\frac{3}{13}$	
4	$\frac{17}{10}$ is an example of improper fraction?	
5	Multiply and divide the **numerator** and **denominator** by the same number to create an equivalent fraction.	

Section C: Short answer

Direction: Answer all the questions. The marks for each question are provided in the bracket.

Question 1

a) Write $\frac{17}{4}$ as a mixed number. [1]

b) List two equivalent fraction of $\frac{4}{10}$ [1]

c) Dechen Wangmo says that $\frac{4}{5} > \frac{1}{3}$. Do you agree with her or not? Show with the help of picture. [2]

Question 2

a) Order from least to greatest. [1 + 1]

i. $\frac{5}{6}, \frac{3}{6}, \frac{1}{6}, \frac{2}{6}$

ii. $\frac{3}{4}, \frac{3}{5}, \frac{4}{5}, \frac{1}{20}$

b) Draw a picture to show why $\frac{18}{3} = 6$ [1]

Question 3

a) Name three types of fractions with example each. [1+1+1]

*******************All the Best*******************

APPENDIX C

IOC FOR LEARNING ACHIEVEMENT TEST

Item Objective Congruence for Test Questions by the Experts

Sl No.	Item Test No.	Expert 1	Expert 2	Expert 3	Average	Congruence
1.	Multiple Choice Question 1	+1	+1	+1	+1	Congruent
2	Multiple Choice Question 2	+1	+1	+1	+1	Congruent
3	Multiple Choice Question 3	+1	+1	+1	+1	Congruent
4	Multiple Choice Question 4	+1	+1	+1	+1	Congruent
5	Multiple Choice Question 5	+1	+1	+1	+1	Congruent
6	True or False Question 1	+1	+1	+1	+1	Congruent
7	True or False Question 2	+1	+1	+1	+1	Congruent
8	True or False Question 3	+1	+1	+1	+1	Congruent
9	True or False Question 4	+1	+1	+1	+1	Congruent
10	True or False Question 5	+1	+1	+1	+1	Congruent
11	Short answer type Question 1	+1	+1	+1	+1	Congruent

12	Short answer type Question 2	+1	+1	+1	+1	Congruent
13	Short answer type Question 3	+1	+1	+1	+1	Congruent
Overall Average					+1	Congruent

APPENDIX D

SEMI-STRUCTURED INTERVIEW QUESTIONS

Semi Structured Interview Questions

The semi-structured interview will be used to determine the student's satisfaction toward the use of multimedia technology in fractions.

The index of IOC core ranges from -1 to +1.

- ✓ +1 indicates that the item clearly matches the stated objectives.
- ✓ 0 indicates that the item is unclear whether the measures meet the stated objectives.
- ✓ -1 indicates that the item is clearly not measuring the stated objectives.

Sl. No	**Attributes**	***+1***	**0**	***-1***
1	Could you describe how you usually learn Mathematics?			
2	How did you feel about learning Fractions using PPT and Video clips?			
3	Do you think the use of PPT and Video clips will help you learn Fractions better? Why or why not?			
4	What did you like most from the lessons? Why?			
5	Would you prefer to learn other topics through the use of PPT and Video clips? Why?			

Semi Structured Interview Adapted from: Tashi, 2019

APPENDIX E

IOC FOR SEMI-STRUCTURED INTERVIEW

Item Objective Congruence for Semi-Structured Interview questions by the Experts

Sl. No	Attributes	Expert 1	Expert 2	Expert 3	Average	Cong-ruence
1	Could you describe how you usually learn Mathematics?	+1	0	+1	0.67	Cong-ruent
2	How did you feel about learning Fractions using PPT and Video clips?	+1	+1	+1	+1	Cong--ruent
3	Do you think the use of PPT and Video clips will help you learn Fractions better? Why or why not?	+1	+1	+1	+1	Cong-ruent
4	What did you like most from the lessons? Why?	+1	+1	+1	+1	Cong-ruent
5	Would you prefer to learn other topics through the use of PPT and Video clips? Why?	+1	+1	+1	+1	Cong-ruent
Overall Average					0.934	Cong-ruent

APPENDIX F

LESSON PLAN

Lesson Plans 1 (Session 1 & 2)

Date:

Class: V **Subject:** Math **Topic:** Fractions **Time:** 90 minutes

Teaching learning materials: Fraction strips, Projector, Laptop, Video clip

Previous knowledge of the topic: They know the basic meaning of fraction.

GNH Value and Skills: skills and procedures**,** Self-awareness, effective communication, interpersonal relationship, etc.

Structure: PPT, video clips and whole class discussion

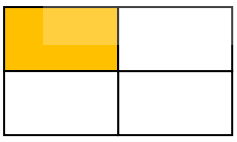
Objective: At the end of the lesson the child will be able to:

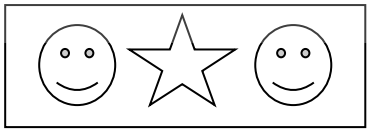
- ✓ Define fraction
- ✓ Define each type of fractions correctly with an example.
- ✓ Find equivalent fractions and relate mix number/fractions to improper fractions correctly after the teacher's explanation.

Introduction (15 mins):

Greeting: As usual greeting and children's responses

Gaining Attention: I will clap my hands to gain students attention and ask few questions regarding the topic that child is going to learn in particular class.





What does this picture show?

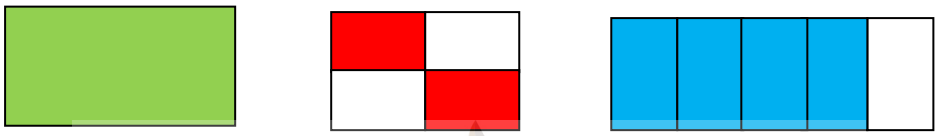
Let them answer the question looking at the diagrams given above and discuss the answer.

[Effective communication, self-awareness]

Lesson development (20 minutes):

What is a fraction? Let students discuss and answer.

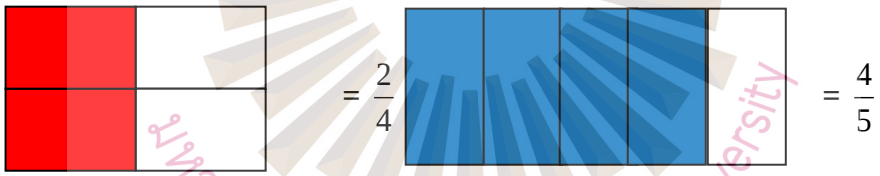
Eg: 6, $\frac{3}{7}$, $5\frac{2}{3}$, $\frac{7}{3}$

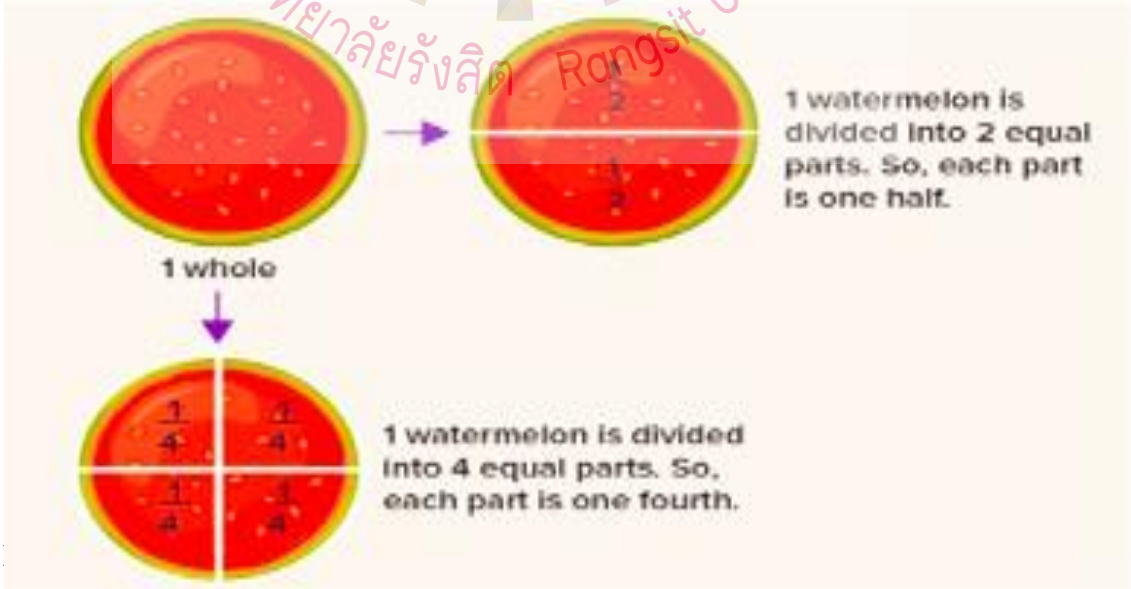


Let them answer looking at the examples given.

Teacher and students will discuss and derive the definition of the fraction as

❖ A Fraction is part of whole, fraction can mean in different things like in shapes, in groups, in lengths and as per the situation. In other words, a **fraction** represents a part of a whole or, more generally, any number of equal parts. When spoken in everyday English, a **fraction** describes how many parts of a certain size there are, for **example**, one-half, eight-fifths, three-quarters.





After learning the meaning of fractions, teacher and students will watch a video clips (approximately 5 minutes) about types of fractions. Necessary instructions will be given to carry out the activity as follows after watching the video.

i. Sort out these fractions into different groups and name them as improper fraction, Proper fraction, and mixed number/fraction?

$$\frac{3}{7}, 5\frac{2}{3}, \frac{7}{3}$$

ii. Define improper fraction with 4 examples.

iii. Define proper fraction with 4 examples.

iv. Define mix number/fraction with 4 examples.

Let few teams to share their answers and disused with others.

[Critical thinking, problem solving, decision making]

Monitoring: The teacher will go round, assess their works and provide necessary support if required.

Follow up of activity (10 mins): Let them do the necessary correction. Ask them their own definition and correct them if required.

Teacher will give the definitions as follows;

- A fraction with the greater numerator than denominator is called an improper fraction.

  Eg. $\frac{4}{3}, \quad \frac{12}{7}, \quad \frac{7}{6}$

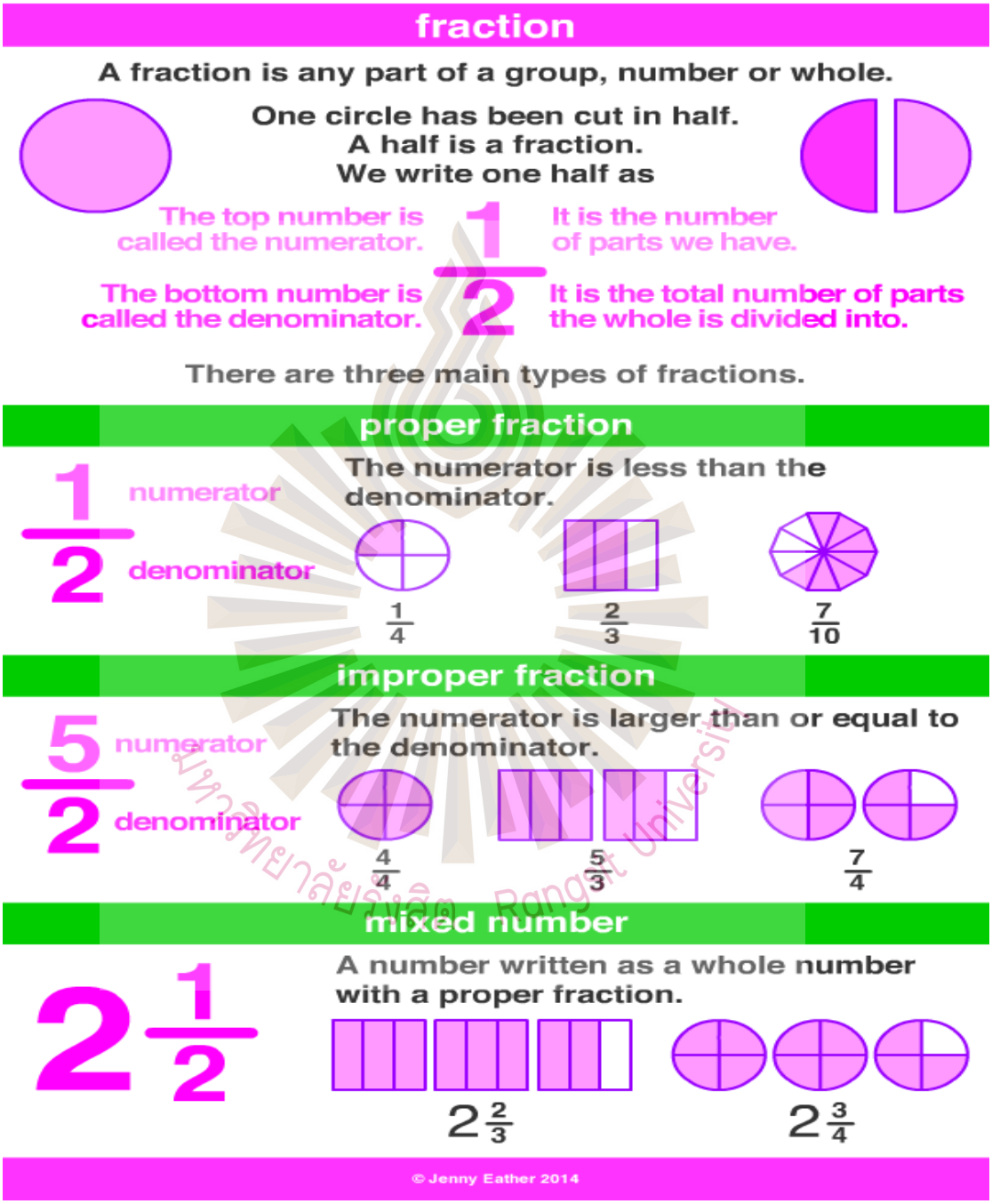
- A fraction with smaller numerator than denominator is called proper fraction.

  Eg. $\frac{3}{8}, \quad \frac{2}{7}, \quad \frac{13}{15}$

- A proper fraction that combines with whole number is called mix number/fraction.

  Eg. $5\frac{4}{7}, \quad 8\frac{1}{3}, \quad 7\frac{7}{9}$

Closure (10 mins): Tr. will summarize the lesson taught with help of following diagram



Note: Teacher will use PPT to carry out the lesson

Video link: https://youtu.be/Ob9YsOTOBYM

APPENDIX G

IOC OF LESSON PLAN

Item Objective Congruence for Lesson Plans by the Experts

Item No	Attributes	Expert 1	Expert 2	Expert 3	Average	congruence
1	Lesson plan 1	+1	+1	+1	+1	Congruent
2	Lesson plan 2	+1	+1	+1	+1	Congruent
3	Lesson plan 3	+1	+1	+1	+1	congruent
4	Lesson plan 4	+1	+1	+1	+1	congruent
Overall Average					+1	Congruent

APPENDIX H

EXPERTS WHO VALIDATED THE RESEARCH INSTRUMENTS

Names of the Expert who Validated the Instruments

Sl. No	Name	Position Title	Institute
1	Dr. Gary Torremucha	Associate Professor	Rangsit English Language Institude (RELI); Rangsit University
2	Kelzang Wangdi	Teacher	Drugyel Higher Secondary School
3	Tenzin Jamtsho	Teacher	Tencholing Primary School

APPENDIX I

PAIRED SAMPLE T-TEST

Paired Sample T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	8.813	32	3.2273	.5705
	Posttest	14.719	32	2.4294	.4295

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-5.9063	2.9633	.5238	-6.9746	-4.8379	-11.275	31	.000

APPENDIX J

RELIABILITY COEFFICIENT

Reliability of Achievement Test Questions

Case Processing Summary

		N	%
Cases	Valid	34	100.0
	Excluded[a]	0	.0
	Total	34	100.0

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.731	.728	17

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
10.76	10.549	3.248	17

APPENDIX K

CONSENT LETTER FROM PARENTS

Parents' Consent Letter

Dear Parents,

I am currently enrolled in the Master of Education in Curriculum and Instruction, at Rangsit University, Thailand. I am conducting a research study on "The Application of Multimedia Technology in Teaching and Learning Mathematics of grade Five Bhutanese Students". This research requires student participation. The instruments involved during the study are pretest and posttest, and semi-structured interview for obtaining the required data. Therefore, I would like to seek your permission to let your child participate in this study. Their names, identifications, and schools will be kept confidential and anonymous.

I look forward to your cooperation in approving your child to participate in this research study.

Thanking you

Yours sincerely
Rigzin
Student
Rangsit University
Thailand.

I acknowledge that the content of this research study has been thoroughly explained to me and any questions have been answered. I have read the letter provided by Mr. Rigzin and have agreed to let my child (……..…) participate in the research as described.

Name: …… Signature: ……..
Date: ……

BIOGRAPHY

Name	Rigzin
Date of Birth	March 24, 1987
Place of Birth	Bumthang, Bhutan
Institution Attended	Paro College of Education, Bhutan Bachelor of Education, 2009 Rangsit University, Thailand Masters of Education in Curriculum and Instruction, 2021
Scholarship	Trongsa Poenlop Scholarship (TPS)
Address	Tang, Bumthang; Bhutan
Email Address	rigtenwangzin87@gmail.com riggs@education.gov.bt