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A Flipped Classroom Approach to Teach Fractions and Decimals in Grade VII at Trashigang Middle Secondary School: A classroom action research

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ABSTRACT

This study employed action research to enhance students' comprehension of fundamental math concepts, particularly fractions and decimals, in response to concerns about subpar math performance among Bhutanese students. The study included 23 girls and 25 boys in the seventh grade and utilized the flipped classroom model to reinforce their understanding of decimals and fractions. While the existing literature lacks a specific focus on this concept, empirical studies suggest that the flipped classroom can improve overall academic performance. The research consisted of three cycles: pre-test, intervention, and post-test. The findings indicated a positive response from students who valued the flexibility of interactive video lessons and collaborative learning. They reported enhanced comprehension, improved performance, and a deeper grasp of the subject matter. However, some students expressed concerns about an increased workload and difficulties in retaining information, underscoring the need for tailored support. Recommendations include personalizing the flipped classroom experience, simplifying video content, and offering supplementary resources to address workload concerns. Additionally, it is essential to provide teacher professional development for effective implementation of the flipped model. Although this study demonstrates the effectiveness of the flipped classroom in improving learning outcomes, it is limited to one grade level and basic concepts.

Keywords: Flipped classroom teaching, Mathematics, Flipped approach.

1. INTRODUCTION

Bhutan, a landlocked country in South Asia sandwiched between China and India, remained isolated from the outside world until the reign of its first monarch, Ugyen Wangchuck, the first hereditary King of Bhutan (1907-1926). It wasn't until 1914, when King Ugyen Wangchuk inaugurated Bhutan's first school in Haa, that the

country began to embrace modern education. Prior to this, monastic education was the only center of learning. Today, the Ministry of Education, along with relevant departments and agencies, is introducing new curriculum, pedagogical skills, content knowledge, human values, and digital literacy to meet the needs of the 21st century. The COVID-19 pandemic has also drastically impacted the delivery and learning in the school education system. Recently, the Department of Curriculum and Professional Development under the Ministry of Education introduced a new National School Curriculum and Assessment methods, which went into effect in 2021. This reform was initiated after His Majesty the King of Bhutan issued a Royal edict outlining the changes on December 17, 2020 in Punakha, Bhutan. The excerpt from The Royal decree on education reform is mentioned below:

"Educationists and experts have identified what twenty-first century competencies mean for children everywhere. By developing their abilities for critical thinking, creative thinking, and learning to be life-long learners, we have to prepare them to be inquisitive, to be problem-solvers, to be interactive and collaborative, using information and media literacy as well as technological skills. We must prioritize self-discovery and exploration, and involve learners in the creation of knowledge rather than making them mere consumers of it. We must make STEM subjects part of their everyday language."

As we prepare our students for the future with knowledge on technology and media literacy, students must know how to apply lessons taught in school to real life contexts. The numerous research and studies on 21st teaching and learning pedagogies to help our learners better and Flipped Classroom is one of them. In this study, researchers aimed to study how effectively flipped classroom can be used in teaching and learning of fractions and decimals in class VII mathematics.

According to Bishop and Embry (2013) the flipped classroom is a new pedagogical method, which employs asynchronous video lectures and practice problems as homework, and active, group-based problem-solving activities in the classroom. They suggested that flipped improved the students' performance compared to traditional classroom. Rotellar and Cain (2016) also stated that the main aim of flipped classroom method is to increase student engagement with content, increase and improve faculty contact time with students, and enhance learning.

1.1. Statement of the problem

According to Reyna and Brained (2007), mathematical proficiency is increasingly recognized as fundamental to both individual and national economic success. Basic numeracy and number literacy are crucial for making informed decisions in everyday life. However, a report by the Bhutan Council for Examination and Assessment (BCSEA) in 2013, through the National Education Assessment, revealed that Class X students scored only 38.03 out of 100 marks on the Mathematics test, indicating a significant underperformance. Additionally, the national mean marks for both Class X and XII in Mathematics over the past decade have consistently been lower compared to other subjects. These findings suggest that students in Bhutan face challenges in comprehending and mastering mathematical concepts, potentially stemming from a weak foundation in numeracy and literacy.

To address this issue and make mathematics more engaging and effective for learning, our research aims to explore the implementation of a flipped classroom approach in teaching fractions and decimals to Class VII students. Mathematics is a compulsory subject in Bhutan's education system from Class PP to X, and our observations have indicated that students tend to

perform below par in mathematics compared to other subjects. Furthermore, the 2021 results for Class VI students at our school highlighted a below-average performance in mathematics. During the pandemic, mathematics teachers also expressed difficulties in delivering effective online instruction.

Considering these challenges and the need to enhance students' understanding of mathematical concepts and problem-solving skills, we propose implementing the flipped classroom model as an innovative teaching approach to improve mathematics education in our school.

1.2. Aims and objectives

The research is intended to fulfill the following objectives:

- How effectively teacher can use flipped classroom to teach fractions and decimals.
- To explore the strategies to use flipped classroom in a meaningful manner.
- To evaluate students' learning through flipped classroom teaching.

1.3. Research Questions

Main Questions: How can we improve students' understanding of fractions and decimal using a flipped classroom?

Sub-questions:

- How to use flipped classroom to teach fractions and decimals in class VII mathematics?
- How to create flipped classroom materials such as video and PowerPoint to improve students' understanding of fractions and decimals?
- How to evaluate students' learning after implementing flipped classroom teaching?

1.4. Reconnaissance

1.4.1. Situational Analysis

Trashigang Middle Secondary School is situated in Samkhar Gewog, Trashigang Dzongkhag, Bhutan, and has a rich history dating back to its establishment in 1960. Currently, the school proudly educates 539 students under the guidance of 32 dedicated teachers, making it one of the most established educational institutions in Trashigang Dzongkhag.

The school offers classes from PP to X, catering to a wide range of students. However, for the purpose of this research, the focus was on class VII. This selection was based on careful consideration, as it was observed that class VII students tended to participate and interact less in the classroom. Additionally, their academic performance in mathematics during the previous year (2021), as indicated by the class VI Board examination results, was below the expected average.

The participants in this study were composed of 23 girls and 25 boys from class VII. Through purposive sampling, we aimed to gain valuable insights into the challenges and opportunities faced by these students in the context of mathematics education.

1.4.2. Literature review

Review of literature is broadly classified into two categories: Introduction to flipped classroom and its perception. In perceptions, the literature is review on benefits, drawback and how flipped classroom is being conducted.

a. What is flipped classroom?

Mok (2014) pointed out that, in a flipped classroom, the teacher gives students with lesson before class in the form of pre-recorded videos, and spends class time engaging students in learning activities that involve

collaboration and interaction. Further, Joanne and Latte (2014) stated that the flipped classroom is a radical pedagogy whereby online lectures take place outside class and active problem solving inside the classroom. Fernandez-Martin et al. (2020) revealed that implementation of Flipped Classroom led to an improvement in students' knowledge and attitudes towards mathematical content and discipline. However, researchers could not find the evidence and empirical research on how flipped classroom is used in teaching and learning of fractions and decimal. Smith (2017) stated that students experience enhanced learning of course content through small group activities, class discussions, and student presentations in a flipped classroom. This also indicated that flipped classroom is inclined more towards students learning centered.

b. Perception on flipped classroom

Wong and Chu (2014) pointed out that flipped classroom model is effective on enhancing learning as it benefitted students from the inclusion of added examples. However, the study was conducted for English subject. Further, Roehling et al. (2017) in psychology course study found out that that most of the students prefer traditional classroom delivery but suggested retaining the flipped approach for some class periods. Smith (2017) pointed out that teacher spend more time assisting students with the learning process, opening up their classrooms to new possibilities and ideas when flipped classroom model is used. Wong and Chu (2014) also stated that flipped classroom help stronger students continued to make progress whereas weaker students would receive more attention individually. It has indicated that flipped classroom help students in retaining and to bring average performer to bring together.

Ramírez, D et.al (2014) pointed out that flipped classroom allow teachers to cover more material and help students to participate in the various activity. However, they stated that students face lots of difficulty in the beginning to adapt to the new strategy of teaching and learning. Furthermore, Muir and Geiger (2016) examined the use of flipped classroom model in grade 10 mathematics learning classroom. They found out that flipped classroom caters to the various mathematical learning needs of the students which optimizes student's comprehension of mathematical concepts. The flexible nature of the model also enables the learners to learn the materials at their own pace, and allows the students to take the responsibility of their own learning. The flipped classroom model also provides the opportunities for the students to learn through collaboration and cooperation, promotes inquiry-based learning, and increases parental participation in their kids' learning (Ruffini, 2014). Singye (2020) claimed that the students had positive attitude and perception of flipped learning approaches. Students preferred flipped approaches over traditional teacher fronted lecture methods. However, the author argued that this strategy may not cater to the learning needs of all types of students. Some students learn more efficiently with technology, but other requires hands on learning to retain new information. Some drawbacks also include the reduction of students' physical activities and there are every possibility of students visiting inappropriate sites and misusing the technology and their time.

1.5. Flipped classroom and learning of mathematics

Lo et al. (2017) identified three key benefits of the flipped classroom approach, which significantly enhance student learning. Firstly, it maximizes in-class time, allowing for more valuable task-oriented activities and practice sessions. Secondly, it facilitates the integration

of new knowledge with students' existing beliefs and understanding, fostering a deeper comprehension of the subject matter. Lastly, the flipped classroom model provides the advantage of real-time feedback, enabling students to receive immediate input and adjust their learning strategies accordingly.

Similarly, Yerizon et al. (2022) conducted research indicating that students who engage in mathematics learning through the flipped classroom approach demonstrate impressive mathematical critical thinking skills. This finding underscores the effectiveness of the flipped classroom model in not only delivering content but also nurturing higher-order cognitive abilities in students.

2. METHODOLGY

2.1. Research methodology

According to Kothari (2004), research methodology serves as a systematic approach to solving research problems or as the scientific study of research methods. The selection of a research method hinges upon the specific research problem (Noor, 2008). In the case of this action research, a mixed methods approach was adopted. To gather qualitative data, interviews and survey questionnaire were conducted with a sample size of 20 random students to gain insights into their feelings and perceptions regarding flipped classroom teaching. These interviews included three open-ended questions. In addition, quantitative data were collected through an achievement test designed to assess students' performance. This test aimed to evaluate the effectiveness of the flipped classroom approach in teaching and learning fractions and decimals among seventh-grade students.

2.2. Population and sampling

It would be ideal if the researcher could investigate the issue within the entire population, but it's often not feasible to study everyone. Therefore, the researcher can select a "sample" that is both sufficiently large and representative of the entire population (Acharya et al., 2013). For this study, the researchers employed purposive sampling, a non-probability sampling method. The research team identified that the performance of grade 7 students in mathematics was subpar. To explore the effectiveness of the flipped classroom in enhancing student learning, a total of 23 boys and 25 girls from grade 7 participated in the study.

2.3. Timeline of the study

This study spanned six months, beginning in May 2022, where students initially received traditional classroom instruction. After completing the topic, a pre-test revealed that students' performance in fractions and decimals was subpar. Consequently, researchers implemented various interventions, including the use of the flipped classroom method, to enhance student learning. Over the course of two months, a total of 120 minutes per week, taken from seven 40-minute mathematics classes, were dedicated to the intervention and flipped learning activities.

3. RESULTS

3.1. Test

The data collection involved conducting both a pre-test

Table 1. Timeline of the study

Month	Activity
April - May	Pre-data collection
June - July	Intervention phase
August - September	Post data collection

and a post-test, with each test scored out of 20, to gauge the baseline knowledge of the students and assess the effectiveness of the flipped classroom strategy as an intervention method. The pre-test revealed a mean score of 6.5 out of 100, indicating that, on average, the students had a relatively low level of understanding or knowledge in the subject area before the intervention. However, after implementing the flipped classroom strategy, there was a remarkable improvement in student performance, as evidenced by the post-test mean score of 12.5 out of 20. This substantial increase in scores suggests that the flipped classroom approach had a positive impact on student learning, significantly enhancing their understanding and proficiency in the subject matter.

For instance, in question number 1, where students were tasked with converting fractions to decimals, around 90 percent initially faced challenges. The achievement test comprised straightforward questions aimed at laying a solid foundation and assessing students' fundamental concepts. They encountered difficulties when it came to converting the denominator into 10, 100, or 1000. Nevertheless, following the intervention, roughly 95% of students displayed the ability to execute this conversion correctly, employing various methods. The achievement test outcomes unequivocally reveal that students struggled with the concept of converting fractions into decimals initially. Conversely, they exhibited a strong aptitude for converting decimals into fractions.

During the pre-test, only 14 out of the 48 students achieved a perfect score of 4 out of 4 in this particular section, with a mean score of 1.4. However, after the intervention, 31 students achieved a perfect score of 4 out of 4, resulting in a mean score of 3.1, clearly indicating the success of the intervention.

Likewise, when it came to representing mixed numbers, numerous students encountered challenges in dividing the numbers during the pre-test. Additionally, some students struggled with the arrangement of the dividend, remainder, and divisor in the given context. However, following the implementation of the flipped classroom strategy, which involved watching instructional videos and engaging in comprehensive discussions, students were able to more effectively grasp this concept.

Before the intervention, only 23 out of 48 students were able to give correct answers. However, after the intervention, there was a significant improvement, with 36 students now correctly expressing fractions as mixed numbers. This positive change in outcomes underscores the effectiveness of the intervention methods used, indicating substantial progress in the students' comprehension of the subject. Additionally, a study conducted by Cevikbas and Kaiser (2020) noted that while teaching mathematics in flipped classrooms presented some challenges, well-designed flipped classrooms provided an excellent opportunity to enhance students' mathematical thinking and understanding.

The test results above indicate that students performed

Table 1. Post-test and pre-test mean

Test	Mean
Pre-test	6.5
Post-test	12.5

well after the intervention, demonstrating their proficiency in utilizing diverse strategies for calculations. A similar trend was also observed in the context of addition and subtraction of fractions.

3.2. Interview

To assess the students' comprehension of the lessons learned, we conducted interviews with a randomly selected group of 20 students. The interviews yielded valuable insights, clearly indicating that students derive great enjoyment from the lessons when the flipped classroom method is employed. This is notably evident in their responses to the question: "What aspects of the flipped classroom method do you find most beneficial for your learning style, and why?"

From the flipped classroom learning from video lesson because it saves time and develops independent learning skills. (Student 1)

The videos because if we don't understand the concept we can watch the videos again and again. (Student 12)

Watching video because while watching video I understood more. (Student 7)

Based on these interviews, it is clear that students value the advantages of the flipped classroom approach, particularly the incorporation of video lessons, which they find helpful in saving time and fostering independent learning skills. A similar study conducted by Atta and Brantuo (2021) also discovered that the analysis of the questionnaire revealed that students enjoyed the lessons and experienced improved performance as a result.

Likewise, in response to the question, "Are there any challenges or difficulties you've encountered while participating in the flipped classroom model? How have you addressed or overcome them?" students reported not encountering any significant difficulties, others mentioned struggling initially to understand certain concepts deeply. To overcome these challenges, students employed various strategies, including seeking assistance from teachers, active listening, taking thorough notes, and repeated viewing of instructional videos. Regarding the advantages, students expressed enjoyment and enthusiasm for the flipped classroom approach, particularly the use of video lessons. They cited the convenience, time-saving aspect, and development of independent learning skills as key benefits. It was evident from the following excerpt:

Faced challenges in understanding in concept deep but overcome by asking to the teacher. (Student 14)

Initially I didn't get the concepts properly but then I listened carefully wrote notes that's how I overcome my problem. (Student 11)

If I have any doubt I watch videos again and again. (Student 17)

I didn't face any challenges while participating in the flipped classroom. (Student 5)

Similarly, in response to the interview question, "What suggestions do you have to make our flipped classroom sessions even more helpful for your learning?" Analyzing the students' comments regarding suggestions for improving the flipped classroom sessions, a diverse range of feedback emerges. Some students expressed a desire for additional time to delve deeper into the content, highlighting the importance of allowing students more opportunities for exploration and discussion. On the other hand, a few students expressed contentment with the current setup, emphasizing that they found the existing structure effective and comprehensive.

Interestingly, some students recommended incorporating group activities and collaborative learning, underscoring their preference for interactive and cooperative approaches to enrich their learning experience. Additionally, several students stressed the importance of video lessons, both for gaining a deeper understanding of the subject matter and for seeking clarification by actively asking questions.

Conversely, a few students expressed concerns about the use of abstract concepts in the flipped classroom, fearing potential difficulties in comprehending such material. They argued that videos should be presented in a simple and easily digestible manner to provide a strong foundational understanding. This sentiment is reflected in the following statement made by students

Create more new video lessons to provide further insights into the topic. (Student 17)

Having more flipped classroom sessions would be beneficial. But video should be only used for those topics which we can build foundation. (Student 10)

I would appreciate more video content and additional explanations needed for some video. (Student 20)

No, I don't have any suggestions, but I find the flipped model very helpful. (Student 9)

4. SURVEY QUESTIONNAIRE

The survey results indicated a positive perception of the flipped classroom model for teaching and learning. Out of the randomly selected 20 participants, 9 students strongly agreed, and 11 students agreed that they found the flipped classroom teaching method enjoyable and effective. This aligns with a study conducted by Hastuti (2020), which discovered that the flipped classroom approach can enhance students' enjoyment of mathematics by designing engaging learning activities. The study also emphasized that students experienced significant improvements in their understanding of the subject matter through watching instructional videos and participating in classroom discussions, highlighting the advantages of this approach. Similarly, 17 students strongly agreed and 3 students agreed that they had sufficient time to prepare for the lesson when the teacher utilized the flipped classroom method.

On the other hand, it's important to note that 7 out of 20 students expressed concerns that the flipped teaching method increases their workload. Additionally, 8 students disagreed with the notion that the flipped classroom helps in retaining information. These observations highlight that, while many students find the flipped teaching method beneficial, there is a subset of students who are grappling with the concept and its demands. This suggests that further support and adaptation may be required to address the diverse learning needs within the classroom and ensure that all students can fully benefit from this innovative teaching approach.

5. CONCLUSION

The study conducted has provided valuable insights into the effectiveness of the flipped classroom model in enhancing students' learning experiences and outcomes. The findings from surveys, interviews, and assessments have consistently indicated a positive perception of this pedagogical approach among students. They appreciate the flexibility, accessibility, and interactive nature of video lessons and collaborative learning.

Furthermore, the positive impact of the flipped classroom on students' understanding of complex concepts has been evident, as they have demonstrated improved performance and a deeper grasp of subject matter. The ability to revisit video content and engage in

active discussions has been instrumental in their learning journey.

While the research has highlighted the advantages of the flipped classroom, it has also revealed certain challenges, such as concerns about the presentation of abstract concepts and the need for simplicity in video content. These insights provide valuable guidance for educators seeking to optimize the flipped classroom model.

6. LIMITATION AND RECOMMENDATION

This study centers on the foundational concepts of fractions and decimals, and it recognizes that students' learning and their positive perceptions of the flipped classroom depend on various factors. Notably, factors like the frequency of video views and watching additional videos were not considered. Future researchers are encouraged to investigate the implementation of the flipped classroom model for teaching more advanced concepts.

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8. CONFLICT OF INTEREST

The author has declared that there is no conflict of interest.

9. SOURCE/S OF FUNDING

NA

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APPENDIX A

Survey Questionnaire

Dear students, please tick (✓) as per the degree of agreement for the following statements.

Statement	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
I enjoyed flipped classroom teaching				
Flipped teaching is better than conventional teaching.				
I understood concept of fractions and decimals more from videos				
We could discuss and share our doubts in flipped teaching				
In a flipped classroom we get time to prepare				
I prefer learning through flipped classroom than direct teaching in the classroom				
Flipped classroom help me in retaining the information				
I am feeling boring to watch the video provided by my teacher				
Flipped classroom increase the workload of students				
The flipped classroom approach has allowed me to learn at my own pace and to focus more deeply on areas where I may be struggling.				

Open ended interview questions:

1. What aspects of the flipped classroom method do you find most beneficial for your learning style, and why?
2. Are there any challenges or difficulties you've encountered while participating in the flipped classroom model? How have you addressed or overcome them?
3. What suggestions do you have to make our flipped classroom sessions even more helpful for your learning?

APPENDIX B

Conceptual test

Questions

1. Write each fraction as decimal

   $\frac{1}{4}$ and $\frac{3}{5}$

2. Write each decimal as fraction

   0.47 and 0.8

3. Which fraction is greater? Show your work

   $\frac{7}{3}$ $0r$ $\frac{11}{5}$

4. Add the fraction.

   $\frac{1}{2}+\frac{3}{5}$

5. Represent fractions given below in mixed number

   $\frac{35}{3}$ and $\frac{17}{6}$

6. Subtract the fraction

   $7\frac{2}{3}-\frac{4}{5}$