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Improving Students' Understanding of Concept and Motivation Towards Learning Physics Through the Use of Multimedia

Tashi Zangpo[1*], Sangay Dorji T[2]

[1,2]Ministry of Education and Skills Development, Darla Higher Secondary School, Chhukha, Bhutan

[*]**Email:** tashizangpo2017@education.gov.bt

Abstract

The study examined the learning outcomes and motivation of tenth grade learners learning physics. This study employed mixed methods, including both quantitative and qualitative design. The physics learning achievement test and the student survey questionnaire were used to collect quantitative data, whilst the researcher's diary was used to collect qualitative data. 40 students of grade ten participated in the study. The quantitative data were analyzed using an Excel spreadsheet and SPSS version 22 to generate descriptive and inferential statistics respectively. The qualitative data was analyzed thematically. The findings showed that students performed better in the posttest than in the pretest, suggesting that the use of multimedia content boosts learners' academic performance. Multimedia allows students to visualize complex concepts, which enhances their understanding and creates an active learning environment in the classroom. It was found to increase students' motivation to learn physics, as it enables interactive and engaging lessons. Moreover, it promotes improvement in students' problem-solving abilities and helps them gain knowledge and skills, as it has the ability to engage students and foster discussions. Therefore, the study shows positive outcomes regarding the implementation of multimedia in teaching physics concepts.

Keywords

Multimedia, Information Communication and Technology, Motivation

Introduction

With the rapid change in technology, youth need to be fully equipped with Information Communication and Technology (ICT). The integration of multimedia in educational settings has become increasingly prevalent in almost all the schools in Bhutan. The utilization of multimedia tools such as videos, animations, and interactive simulations holds immense potential in enhancing teaching and learning experiences (Hwang & Wu, 2014). Some studies suggest that teacher-centered teaching is still practiced when educational media, particularly interactive technologies,

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are newly introduced into the classroom (Mercer et al., 2011). However, despite the availability of multimedia materials, there remains a gap between the potential benefits of multimedia integration and its effective implementation in classroom practice (Kara-Soteriou & Vosniadou, 2017).

The term ‘multimedia’ refers to the presence of both visual material (static images such as illustrations or dynamic images such as animation) and verbal material (printed words or spoken words), which, in this context, are used to inform and explain new knowledge to learners (Issa et al., 2013).The integration of multimedia into our daily lessons has become necessary as it promotes fun learning experiences among students and enhances the academic result.

Bhutan's education system has witnessed significant advancements in recent years, including efforts to integrate technology including multimedia resources into teaching practices (Tshering & Samuel, 2016). Amin et al. (2018) pointed out that multimedia in English classrooms benefited by bringing about a dramatic and dynamic change in the classroom atmosphere as well as in the teaching techniques. Multimedia plays an important role in the classroom to promote students learning and helps to engage learners. Moreover, multimedia helps teachers to deliver a lesson not only verbally but also visually which greatly helps students to concentrate more in the class. The use of multimedia has resulted in a significant improvement in students understanding of physics concepts (Chen et al., 2010). Multimedia integration into classroom teaching has a positive impact and high satisfaction among students in science and other subjects.

Many studies conducted by Bhutanese and people around the world have shown positive results. Dorji et al. (2022) indicated that students expressed high levels of satisfaction with using multimedia technology for learning science. This approach not only facilitated better comprehension and engagement during lessons but also presented enjoyable and stimulating challenges. Technology has the potential to enhance student engagement, foster independence, and promote collaboration. It also contributes to reducing teachers’ workload (Diallo, 2023).

Multimedia in teaching physics caters to diverse learning styles. The research conducted by Hwang and Wu (2014) found out that the visual learners may benefit from animations and diagrams, auditory learners from narrated explanations, and kinesthetic learners from interactive simulations. Kapri (2017) also supported by finding out that multimedia facilitates the adoption of simplified teaching strategies, fostering easier comprehension among students and subsequently enhancing their academic performance in science subjects. Moreover, multimedia tools enable students to visualize abstract scientific phenomena and conceptualize complex processes more effectively. Virtual simulations and interactive animations provide learners with dynamic representations of scientific concepts, allowing them to manipulate variables and observe real-time outcomes (Smetana & Bell, 2012). The findings of Wangdi (2017) also suggest that lessons enriched with multimedia elements captivate students' focus and cultivate inherent motivation, especially in subjects such as science, where grasping abstract concepts can pose challenges.

Therefore, the study aims to investigate the effects of using multimedia on students’ learning performance and motivation in learning physics. It is certain that the concept of physics can be taught through text, graphics, audio, video, animations, and PowerPoint presentations. The use of variety of tools immensely increases students' interest and motivation toward learning physics.

Methodology

Data Collection Tools

This study employed mixed methods to collect measurable and objective views on multimedia towards improving understanding of concepts and students' motivation in learning physics. Quantitative data collection in this action research includes physics learning achievement tests, and survey questionnaire associated with students' motivation. A research diary was maintained throughout the study which is used to collect qualitative data. It analyzes the deeper understanding of students' motivation in learning physics.
Table 1 shows research design for the study.

Table 1. One group pretest-posttest design

Group	Pretest	Treatment	Posttest
1	O_1	Multimedia	O_2

Note: O_1: Pretest before the treatment, O_2: Posttest after the treatment

Sampling:

The non-probability sample technique was used to select the participant because a researcher has the right to choose the sample in non-random ways. Specifically, the purposive sampling method was used to select participants as they were purposively selected due to quality they possess and offered intervention. The 40 tenth-grade students took part in the study as they are the only students learning physics in grade ten. Moreover, it is purely based on researcher knowledge and judgement to select participants as researchers know them well. The data collection tools used in this study are Physics learning achievement test, survey questionnaire and researcher diary.

Data Analysis tool

Quantitative data was analyzed using an Excel spreadsheet and IBM SPSS 22. The quantitative data was interpreted based on descriptive and inferential statistics. The pretest and posttest were analyzed using IBM SPSS 22 to check the normality of the data. Further, Inferential statistics such as t-test was used to compare the pretest and posttest. Descriptive statistics were used to describe the means and standard deviations. The Braun and Clark steps were used to analyze the qualitative data.

Ethical Consideration

A researcher adhered to the code of conduct and ethics of research. This study is carried out without violating the ethics of research. Ethical consideration in data collection plays a crucial role in conducting research. The participant will be treated with utmost respect. The researcher will seek permission before collecting data. In addition, confidentiality and identity would be protected by using anonymity.

Results and Discussion

A Shapiro-Wilk test was conducted to check and determine the normality. The data are normally distributed as the significant value for both the tests were greater than 0.05. Therefore, a parametric test was administered to analyze the data.

Table 2. Normality Test

Test	Sig.
Pretest	.059
Posttest	.069

A paired sample t-test revealed that the posttest had significantly higher mean scores (*M*=15.80, *SD*=2.50) than the pretest (*M*=9.73, *SD*=3.23). This indicates that the lessons taught with the aid of multimedia did better than without multimedia. Moreover, it is found that the intervention is statistically significant based on the *t*-value of 9.87 and which *p*-value is less than 0.01 with large effect size as shown in table 3. There is strong evidence that the teaching intervention using multimedia improves students' performance in learning physics.

Table 3. Comparison of pretest and posttest

	Mean	Std. Deviation	T	Df	Sig. (2-tailed)	Cohen's d
Pretest	9.73	3.23	9.87	39	.000	1.56
Posttest	15.80	2.50				

Note. N=40, *Significant level at p<.01

Table 4 represents the average mean scores in all three domains of students' opinion toward multimedia. The composite mean for students' motivation (*M*= 4.45, *SD*=.67), understand the concept (*M*= 4.17, *SD*=.62), and the interesting lesson (*M*= 4.31, *SD*=.60) were rated all above high to very high. It is found that students experience interesting lessons and motivated to learn the physics concepts on using multimedia.

Table 4. Students' opinion toward multimedia

	Mean	Std. Deviation	Level of Interpretation
Motivation	4.45	.67	Very High
Understand the concept	4.17	.62	High
Interesting Lesson	4.31	.60	Very High

Note. N=40, Adapted Qualitative Interpretation of 5-Point Likert Scale Measurements of Pimentel (2010)

The qualitative data revealed that multimedia motivates the learners and provides them with an opportunity to learn the concept well. Multimedia creates a conducive learning atmosphere as it provides enriching and valuable time in the classroom. The lesson was found to be enjoyable, interesting, engaging and fun learning as it provided opportunities for group interaction and discussion. The learning resources were more relevant, and it was helpful to make the learners

enjoy the lesson. Interactive lessons make the learner actively participate in the classroom discussion as they allow students to interact with multimedia tools.

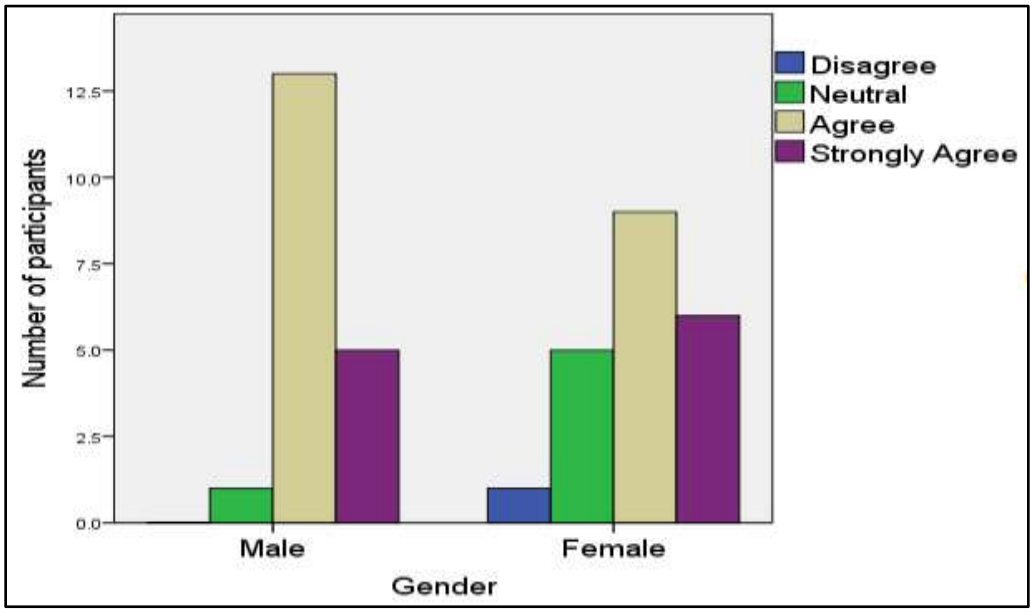

Figure 1. Multimedia helps me to improve my ability to solve new problems

The male students rated high in 'Agree' category followed by 'Strongly Agree' level. Similarly, most of the female students rated high in 'Agree' category followed by 'Strongly Agree' level however, 5 females rated Neutral and few female students with disagree on the statement 'multimedia helps me to improve my ability to solve new problems'. This indicates that male participants were benefited from multimedia for solving problems.

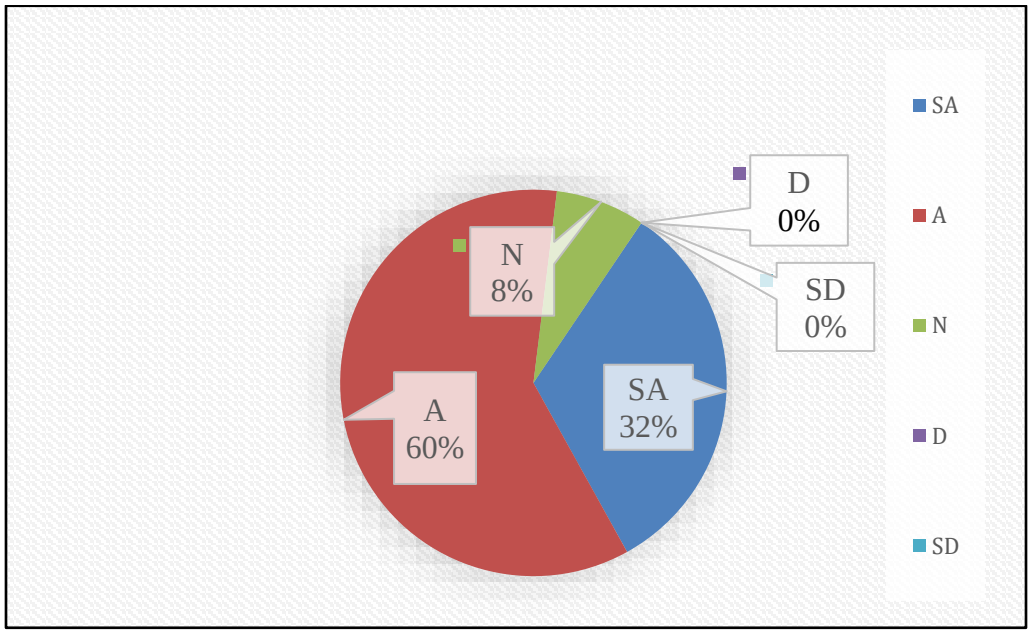

Figure 2. Multimedia helps me to improve understanding of theories

Figure 2 showed that 60% of the participants rated agree and 32% strongly agree indicating multimedia help to understand the theories. However, 8% rated neutral category. Similarly, the qualitative data showed that learning the principles and theories of physics using videos encourages students to get a clear picture of the concept and understand its application in daily life. It comprehends the physics lessons. The use of multimedia in classroom helped learners to understand physics effectively.

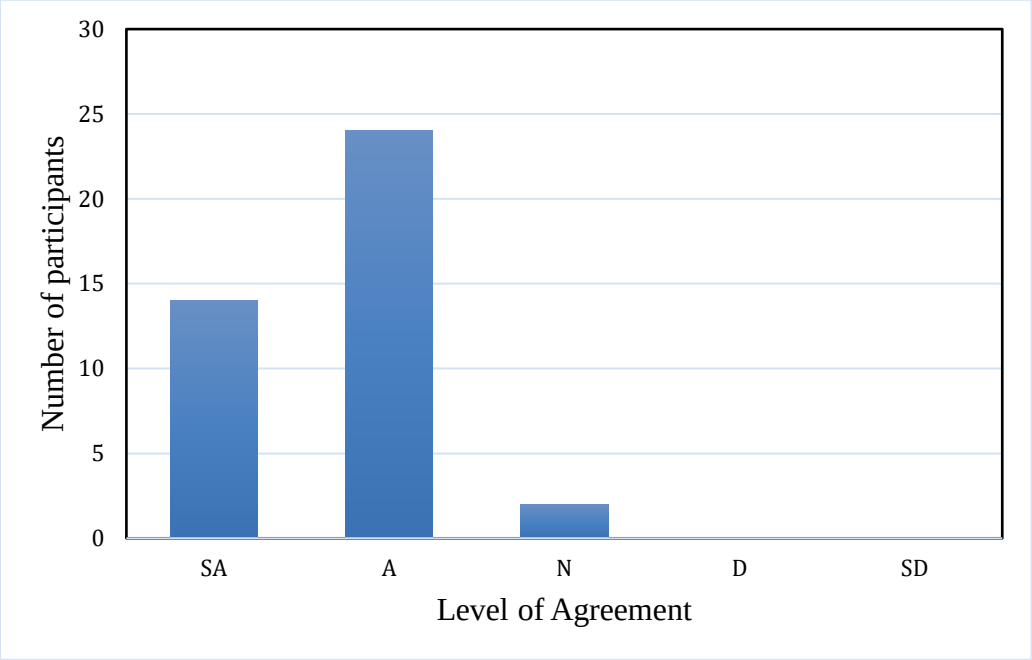

Figure 3. Multimedia improves my knowledge and skills

The 24 students and 14 students graded Agree and Strongly Agree respectively for the statement 'multimedia improves my knowledge and skills' with 2 participants in Neutral agreement. Likewise, qualitative data found that multimedia stimulates learners thinking and improves learning environment in the classroom. It helps learners to stay focused and attentive, leading to improvement in knowledge and skills.

Discussion

This section discusses the key findings of students' learning of physics based on pretest - posttest scores, students' opinion and attitudes toward multimedia. The findings were compared to the existing literature and interpreted.

The statistically significant difference was performed using a paired sample t-test based on the test scores of the learner. The data confirmed that there was a highly statistically significant difference in learning performance between the pretest and posttest. The learner performed better in posttest than pretest. This occurs due to the researcher providing learners with multimedia aids such as PowerPoint presentation, YouTube video, interactive video and virtual lesson on physics concepts. Learners enjoyed and engaged in the learning in the classroom. It is apparent from the study that multimedia helps learners to learn the physics concept better and resulted improvement in students' comprehension. This finding was supported by Chen et al. (2010) that the use of multimedia has shown significant improvement in students understanding of physics concepts. Similarly, Kapri (2017) echoed multimedia enhances the academic performance in science

subjects. It improves collaborative learning and provides a more entertaining platform for 21st generation students so they can learn more efficiently and effectively. Multimedia is more effective for learning and understanding physics. It increases concentration and interest in a particular topic. The findings are consistent with those of Dorji et al. (2022) and Wangdi (2017). Multimedia has changed the way they learn physics. Although it is quite difficult to understand physics concept, the implementation of multimedia has had a positive impact on learning physics. Multimedia enhances students' understanding of the concept through visual and videos.

The results from the student survey indicated that the use of multimedia in classroom teaching has positive learning experience. It was reported that a better understanding of the physics concept in the multimedia session, the lesson delivered was interesting and high motivation towards learning physics. The learning scenario was found to be enjoyable as the multimedia session was more interactive and entertaining. It is evident from the quantitative data that the learner has motivated and found the physics lesson interesting. The findings were validated by Wangdi (2017) that lessons taught with multimedia elements help students' focus and promote inherent motivation. Moreover, Rohman et al. (2022) suggested that the use of video learning can increase student motivation. Furthermore, the use of multimedia has boosted students' knowledge and skills, and ability to solve new problems in learning physics.

Conclusion

This study demonstrated how using multimedia has enhanced students' comprehension and inspired them to learn the concepts. Compared to the pretest, students who were given the multimedia learning concept performed better on the posttest. The results suggest that educational technologies such as PowerPoint, videos, images, and virtual experiments improve students' attitudes towards learning physics. Overall, integrating multimedia into physics education leads to better comprehension, increased motivation, and improved academic performance of the learners.

However, the inadequate knowledge and skills in using multimedia tools to prepare interactive videos and PowerPoint presentations posed a challenge during the study. In addition, the small sample size limited the generalization of the findings to a larger population. Limited time and resources for developing multimedia materials also affected the smooth implementation of the intervention. Therefore, future researchers could focus on larger sample sizes and strengthen knowledge and skills in the use of multimedia tools.

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