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The Attitude of 10th-Grade Students in Learning Physics

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Abstract

The study was conducted to understand the attitude of 10th-grade students of Phuentshothang School, Bhutan, to know their interest in physics for reflective planning and teaching. The quantitative study was carried out using a survey research design. Research questionnaires were validated with Cronbach's alpha of 0.76, greater than 0.7. Data were analyzed with descriptive statistics and Paired t-test for two samples mean using Microsoft Excel. The findings revealed a high personal interest in learning physics and problem-solving in physics with a significant gender difference with $P<0.05$, where male students showed higher personal interest and positive attitude in solving physics problems compared to the female students. The participants expressed a high positive attitude in terms of linking physics to the real world with no significant gender difference. The participants also responded to having a high positive attitude toward the time and effort needed to learn physics, where no significant gender differences were observed. There was a negative attitude toward understanding laws, theories, and physics concepts with no gender difference. Recommendations are made to the subject teacher based on the findings.

Keywords: Attitude, gender difference, physics, problem-solving, students.

Introduction

Education has a fundamental role in the development of any nation. The opportunities for youth with technical and scientific knowledge and the importance of science and technology are rapidly growing globally in the 21st century (Villa & Candeias, 2020). We live in a world that is continuously changing; therefore, the facts and the technologies that we use today might change over time (OECD, 2016). The Science curriculum teaches children the correct process of discovering knowledge and its limitation (Tytler, 2014).

Many countries are trying to increase the number of students taking up science subjects (Mbonyiryivuze et al., 2021) as the number of technically skilled graduates directly impacts the country's development. Increasing the number of science students by providing quality education has more probability of producing more scientists, scholars, and researchers that would benefit a country at large. To achieve the aim of producing more technical graduates, the country must motivate more students to take up science subjects. Bhutan, one of the

developing countries in Asia, has a shortage of manpower in the technical field despite having many jobless graduates. The need for technology-savvy graduates will remain the center of focus for many years to come. On the other hand, physics has a direct relation to producing technologically sound graduates.

Giancoli (2014) defined physics as a science that deals with behavior and natural phenomenon that takes place in and around us today. Kaya and Boyuk (2011); Murunga et al. (2019); Olusola and Rotimi (2012); Reid and Skryabina (2002) found students admitted physics to be a tough and challenging subject, and as a result, they showed a negative attitude toward learning physics. Despite this observation, there is a good section of students willing to take up physics as their career of the assumed challenges. The attitude of students is correlated to learning and academic performance in any subject. Students who do not have an inner drive to learn a particular subject will not invest all their effort to learn. For that reason, such students will achieve poor academic scores and further get demotivated. Kara (2010); Villa and Candeias (2020) stated that the positive attitude of students motivates them to work hard to obtain new knowledge. Motivation plays a vital role in persuading students' interest and attention toward learning (Lasisi, & Samaila, 2020). Physics, among the other science subjects, are considered to be the most perplexing subject by its nature. Therefore, it attracts fewer students to universities from secondary schools (Ibrahim et al., 2019). Similarly, Veloo, Nor, and Khalid (2015) stated that physics is not so popular and considered a boring subject, particularly in rural secondary schools. They also pointed out that, according to the teachers in schools, poor achievement of students in physics was due to students' negative mindset toward physics. It is crucial for physics teachers to understand their students' attitudes towards physics, and motivate the learners to learn physics. If the learners already possess a positive attitude towards learning physics, the teacher can still motivate them by encouraging them to do better.

This study is performed with the objective of understanding the attitude of class ten students on learning physics. The area of study includes their personal interest in physics, attitude in terms of linking physics to the real world, time and effort needed to learn physics, attitude toward solving numerical problems, and attitude of students on understanding laws and concepts of physics. The study will also look for the relationship between personal interest in physics and their academic achievements and difference in attitude toward learning physics based on gender.

A number of studies have been conducted on understanding the attitude of students toward physics in other countries, but there are limited studies conducted in Bhutanese schools. Therefore, as a physics educator, I felt obliged to understand the interest of students in physics so that teachers can have the right intervention in encouraging and motivating them to keep their interests alive.

The study anticipates finding a positive learning attitude of students in learning physics while, with the variation in their attitude based on gender. Centered on the observation made in the class, girls are expected to have a better learning attitude compared to boys.

Background

The student participants were previously studying at three different schools of Phuentsholing municipal, under Chhukha district, Bhutan. Their schools were closed for four months starting 17th March 2021 owing to COVID 19 pandemic. With the decision of the government, students of classes IX to XII were relocated to a new and safe district to enable them to have contact teaching. Eight hundred and seventy-two students of three schools were quarantined and reached a newly constructed school on 31st August 2021, after which they started their contact teaching.

As most of the students and teachers were facing each other for the first time, the researcher felt it crucial to understand students' attitude toward the right and timely intervention. There are many factors contributing to the type of attitude students have. The ambition of students who may not demand physics, students' option to take up commerce or arts in their higher classes and change in the teacher could be some of the factors affecting students' attitude toward physics. Physics is considered a minor subject; grading is done separately, but final marks are obtained by combining together; physics, chemistry, and biology. Students can still pass even if they score zero in three science subjects and pass in all the other subjects.

Literature review

Attitude is defined as mental preparation for action that decides physical actions based on one's belief that determines what a person sees, thinks, hears, and does (Barros & Elia, 1987). Attitude can further be described as a belief that is embedded in people, like the knowledge that helps one to think and assess external factors. Attitude can be positive or negative (Soomro et al., 2011).

Attitude, personal interest, and motivation are seen as important factors impacting the rate of teaching and learning of any curriculum (Lavonen et al., 2021). Astalini et al., (2019) claim that students with a positive attitude to learning physics will greatly influence their academic achievement. However, there are several research findings that show the high positive attitude of students toward physics but contradict their performance in the subject in exams. Several studies have also found that students have negative attitudes toward learning Physics.

A high positive attitude was observed among 760 ninth-grade students in the study conducted by Soh et al. (2010). Similarly, Kaya and Boyuk (2011) studied the attitude of 295 grade 9 to 11 students using the quantitative method and found students to have a high positive attitude toward learning physics. The study also revealed that the ages and grade of the students impacted their attitude to the learning of physics. Studies conducted by researchers such as Godwin and Okoronka (2015); Sen (2013); Kapucu (2017); Ibrahim et al. (2019), and Gurler & Baykara (2020) found a high positive attitude of students toward learning physics. On the other hand, Jones and Hamer (2022) concluded through their studies that the attitude of parents influenced the attitude of students. Parents who understood the importance of physics had their children motivated showing higher positive attitudes toward learning physics. Reid and Skryabina (2002) at different times, found students' negative attitudes towards physics in a study conducted with 850 students aged 10 to 20 years. Among science

subjects, Physics was believed to be difficult and less appealing, due to which, students opted for physics only to obtain employment rather than learning through personal interest. The majority of the students did not take physics elective as a choice (Xavier & Croix, 2016) which resulted in a lack of personal interest in learning physics (Olusola & Rotimi, 2012) that, impacted their attitude and grades (Villa & Candeias, 2020) so they did not understand the course well. Similarly, studies conducted by Olusola and Rotimi (2012); Murunga et al. (2019); Choudhary et al. (2019); Villa & Candeias (2020); Mbonyiryivuze et al. (2021) using various samples found a common negative attitude of students towards learning of physics.

The ability of students to link physics to the real world would make it easier and more fun to learn physics. There are limited studies conducted to see the ability of students to connect the concepts of physics to the real world. In a quantitative study conducted in Rwanda with 380 students, Mbonyiryivuze et al. (2021) found that 39% of the students felt that physics is not related to real-world experience. The study also found that majority of the students have a negative attitude towards physics as it requires significant time and effort to learn physics, unlike other subjects. Physics requires analytical and problem-solving skills. Similarly, findings revealed students have a negative attitude towards solving numerical problems in physics; the majority of Rwanda students stated that physics is more of memorizing facts and formulas. Some students are self-motivated to learn physics, while others need someone to constantly motivate them to keep their interest alive in learning the subject.

The literature reviewed shows a mixture of the positive and negative attitudes of students toward learning physics. While gender difference was significant in some studies, it was insignificant in others. Although several types of research were conducted on the attitude of students toward physics in other countries, there is a limited study conducted in Bhutan. Thus, it was found essential to conduct a study to understand the views of students. There are also limited studies carried out to understand the attitude of students towards solving numerical problems, linking physics to day-to-day experience and attitude towards laws and theories. Therefore, the purpose of the study was to investigate the attitude of students towards physics and various areas of physics, such as problem-solving, ability to link concepts of physics to the real world, time and effort required to learn physics, and attitude towards theories and laws of physics.

The present review builds on and extends with the following research questions and Hypotheses:

Research questions

1. What is the attitude of class ten students towards physics?

2. What is the difference in the attitude of students towards physics based on gender?

Hypotheses

H^1. Students have a positive attitude towards learning physics.

H^2. There is a gender difference in the attitude of students in various aspects of learning physics, with female students possessing better learning attitudes than male students.

Methodology

The attitude of grade ten students toward physics at Phuentshothang School was studied using a descriptive survey design. A quantitative method was adopted for the study as the nature of the study was to find out the existing attitude of the large number of students involving the analysis of numerical data.

Research instrument

The survey questionnaire was developed with 5-point Likert scale items, which was adapted from the work of Mbonyiryivuze et al. (2021); Soh, et al. (2010) with a slight modification and contextualization. A reliability test was done, and Cronbach's alpha was calculated to be 0.76. The survey questionnaire consisted of five areas: students' personal interest towards physics, students' attitude in terms of linking physics to the real world, attitude in terms of attitude and effort needed to learn physics, attitude toward problem-solving in physics, and students' attitude towards understanding concepts of physics. There were three items related to an area of personal interest in physics and four items in other areas, which make 19 items in total. The printed questionnaire was distributed by the subject teachers to collect the data from the students.

Sampling

A systematic sampling technique was used to collect data with a confidence level of 95% and 5% error. The first 11 girls and 11 boys, as per their class name list, were selected from each class. Data were collected from a total of 176 participants, where data from 2 participants were rejected during the data cleaning due to incomplete responses. Responses from a total of 174 participants, N=88 (50.6%) male and N=86 (49.4%) female, were used for the study.

Data analysis

Descriptive analysis was done with the comparison of the mean and standard deviation of each item to study the attitude of students under various themes. Moreover, a paired t-test with two samples for the mean was done to further analyze the significance of gender differences under each theme.

Findings

This section represents the findings of a quantitative study using survey questionnaires to understand the personal interest of the students in learning physics, the attitude of students in linking physics to the real world, attitude in terms of time and effort needed to learn physics, student's attitude toward problem-solving in physics, attitude toward studying laws and concepts of physics, and prevalence of gender difference under each category.

Table 1 represents students' personal interest in physics. There are three items under which students have agreed (with the $\bar{x}$=4.02±0.9) that every student must learn physics, stressing that physics is an important subject to learn. Learning physics improves one's life scored high (with $\bar{x}$=3.9±0.9), while students also agreed (with $\bar{x}$=3.5±0.8) that learning physics is fun. On an average, students showed a high positive attitude agreeing that they are personally interested in learning physics (with $\bar{x}$=3.81±0.87).

Table 1. Students' Personal Interests Towards Physics

Items	$\bar{X}$	SD	Level
1.1 Learning physics is fun	3.5	0.8	High
1.2 Learning concepts of physics improves one's life	3.9	0.9	High
1.3 I think every student must learn physics	4.02	0.9	High
Total	3.81	0.87	High

Table 2 represents students' attitude in terms of linking physics to the real world where students agreed with the highest mean ($\bar{X}$=3.9±0.9) in this category stating that physics is related to what they experience in day-to-day life. Students agreed (with $\bar{X}$=3.6±0.98) that learning physics helps them understand everyday situations in their life. They also agreed (with $\bar{X}$=3.6±0.91) that reasoning skills developed through the learning of physics will be helpful in their everyday life. The statement shows that what they study in physics has related to what they experience in their real world scored high (with $\bar{X}$=3.6±1). The average students' responses show that students have a positive attitude toward linking physics to the real world.

Table 2. Students' Attitude in Terms of Linking Physics to The Real World

Items	$\bar{X}$	SD	Level
2.1 Learning physics helps me understand situations in my everyday life.	3.6	0.98	High
2.2 Reasoning skills used to understand physics can be helpful in my everyday life	3.6	0.91	High
2.3 Physics laws relate to what I experience in the real world.	3.6	1	High
2.4 The subject of physics has a relation to what I experience in everyday life.	3.9	0.9	High
Total	3.68	0.95	High

Table 3 shows the attitude of students in terms of time and effort required to learn physics, where item 3.1 scored the highest mean of $\bar{X}$=4.4±0.89, students strongly agreed that anyone who invests enough time and effort in learning physics would be able to understand and perform well in physics. When students were not able to solve any problems on their own, students agreed (with $\bar{X}$=3.8±1.1) that they get help from a teacher or their friends. The participants also agreed (with $\bar{X}$=3.5±0.9) that they are able to apply the laws and concepts they learn in physics to their real-life instead of simply memorizing them for the purpose of examinations. Students also agreed (with $\bar{X}$=3.2±0.76) that they read the text well and worked through realistic examples that demonstrate concepts of physics. On average, attitude in terms of time and effort needed to learn physics showed high (with $\bar{X}$=3.73±0.93), stating that students invest enough time and effort to learn physics.

Table 3. Attitude in Terms of Effort and Time Needed to Learn Physics

Items	$\bar{X}$	SD	Level
3.1 If we study hard enough, almost everyone can understand physics.	4.4	0.89	Very High
3.2 I thoroughly read the text and work through many realistic examples that demonstrates physics concepts.	3.2	0.76	High

3.3 I can apply physics concepts in a real-life situation, instead of memorizing it.	3.5	0.97	High
3.4 If I cannot solve a problem within 10 minutes, then I get help from friends or teachers.	3.8	1.1	High
Total	3.73	0.93	High

Table 4 represents the attitude of students toward solving problems related to physics. The participants agreed (with the highest mean of $\bar{X}$=4.1±0.96) that solving physics problems is easy if factors are understood well in the given condition, followed by choosing the right formula, which is an important part of solving numerical problems in physics (with $\bar{X}$=3.9±0.9). They agreed (with $\bar{X}$=3.7±0.95) that they can relate the concepts learned in mathematics in solving numerical problems in physics. I enjoy solving numerical problems in physics has scored the lowest mean among the four items under the category of attitude towards solving problems in physics (with $\bar{X}$=3.5±1.1). In general, students had a high positive attitude towards solving numerical problems of physics (with $\bar{X}$=3.8±0.98).

Table 4. Student's Attitude Towards Problem Solving in Physics

Items	$\bar{X}$	**SD**	**Level**
4.1 I enjoy solving numerical problems of physics.	3.5	1.1	High
4.2 Choosing the right formula is the most important part of solving the problem in physics.	3.9	0.9	High
4.3 Problem-solving is easy if we understand the question with the situations and factors affecting it.	4.1	0.96	High
4.4 I can relate the concepts learned in mathematics to solving physics problems.	3.7	0.95	High
Total	3.80	0.98	High

Table 5 represents the attitude of students toward understanding theories, laws, and concepts of physics. Students agreed (with $\bar{X}$=3.7±0.98) to the statement that one of the most difficult aspects of learning physics is to understand the laws and concepts of physics. They moderately disagreed (with $\bar{X}$=3±1.1) that the equations they learn in physics do not help their understanding of concepts of physics. They also moderately disagreed (with $\bar{X}$=3.2±1.2) with the statement that they could not understand laws, theories, and concepts of physics on their own. The participants also agreed (with $\bar{X}$=3.4±1.1) that they must memorize the equations as there is no way they can understand them.

Table 5. Attitude Towards Laws and Concepts of Physics

Items	$\bar{X}$	**SD**	**Level**
5.1 The most difficult aspect of learning physics is remembering the laws and the concepts of physics.	3.7	0.98	High
5.2 Physics equations do not help me to understand the concepts of physics.	3	1.1	Medium
5.3 I cannot understand the laws and concepts of physics on my own.	3.1	1.2	Medium
5.4 There is no other way to remember equations than to memorize it.	3.4	1.1	High
Total	3.3	1.10	High

Table 6 represents the findings of paired t-tests for the sample mean between males and female to study the gender difference under various categories as discussed below.

There was a significant gender difference in students' personal interest in physics. Male students were more interested ($\bar{X}$=3.9) than female students ($\bar{X}$=3.7) with P<0.05. There was no significant gender difference in the attitude of students in terms of linking physics to the real world, their attitude toward the time and efforts required to learn physics, and the attitude of students toward understanding laws and concepts of physics. A significant gender difference was observed in their attitude toward solving problems of physics, with male students slightly higher ($\bar{X}$=3.8) than female students ($\bar{X}$=3.7) with p<0.05.

Table 6: Gender Difference Among Male and Female Students

Themes	**Gender**	$\bar{X}$	**p-value**
3.1 Students' personal interest in physics	Male	3.9	0.019
	Female	3.7	
3.2 Students' attitude in terms of linking physics to the real world	Male	3.8	0.101
	Female	3.7	
3.3 Attitude in terms of effort and time needed to learn physics	Male	3.7	1
	Female	3.7	
3.4 Student's attitude towards problem solving in physics	Male	3.8	0.027
	Female	3.7	
3.5 Students' attitude towards laws and concepts of physics	Male	3.3	0.788
	Female	3.2	

*p = 0.05

Discussion

Several factors influence the learning attitude of students. Gender, variation in structures, variation in curriculum, and personality could be a few defined factors influencing learning attitude (Osborne et al. 2003). The study was conducted with the postulate of finding the positive attitude of students with gender differences, where female students were expected to have better learning attitudes compared to males.

The high positive attitude of students indicates a personal interest in learning physics. The students are intrinsically motivated, so they take learning physics as fun, think that learning physics will improve their lifestyles, and urge every other student must learn physics. The result of the study is similar to the finding of Sen (2013); Ibrahim et al. (2019); Kaya and Boyuk (2011); Soh et al. (2010); Godwin and Okoronka (2015) which were conducted at Kalang, Turkey, Selangor, and Nigeria, respectively. The similarity in the findings indicates better teaching-learning facilities that keep their students motivated to learn physics. The other factor could be that students taking physics get better job opportunities. Eighty-five percent of the students in the work of Olusola and Rotimi (2012) stated that they do not get a job after studying physics which demotivates the learners. In Bhutan, students taking science streams in classes 11 and 12 are highly regarded and are provided with more scholarship opportunities which could be an additional factor motivating the learners. The respondents in the study of Reid and Skryabina (2002) stated that they do dislike physics

because it is not a compulsory subject, whereas physics is a major and a compulsory subject for students taking science streams in classes 11 and 12 in Bhutan. The other studies by Villa & Candeias (2020); Reid and Skryabina (2002); Olusola and Rotimi (2012); Murunga et al. (2019); Choudhary et al. (2019) found students to possess negative attitudes, which contradicts the findings of the study. The varied responses could be due to the variation in the attitude of parents, as the learning attitude of parents influences their children (Jones & Hamer, 2022) and the availability of future scope for those taking up science streams.

The study found significant gender differences, with male students showing greater personal interest than female students in learning physics, which is similar to the finding of Trivedi & Sharma (2013) in India. Female students were expected to have a better positive attitude compared to boys based on their active participation in the class and their academic score, but in reality, males outdo their counterparts.

The positive attitude of students in linking physics to the real world, similar to the findings of Mbonyiryivuze et al. (2021) shows that students were able to link what they learn in the class to their day-to-day experience. The ability of students to link physics to the real world can also be one of the factors that lead to motivating positive attitude in students to learn physics. The gender difference in terms of linking physics to the real world was not significant, which indicates both the male and female students equally can understand and relate what they learn in the class to the real world.

The high positive attitude in terms of time and effort required to learn physics (Mbonyiryivuze et al. 2021) indicated the belief of students that those who invest enough time and hard work in learning physics will be able to perform well. The student respondents have a positive attitude to physics so that they read the text well, which builds their efficacy and motivates them.

A high positive attitude toward solving problems of physics confirms their drive to learn. Their positive attitude plays a vital role in encouraging them to explore solutions to tough problems in physics. There was a significant gender difference ($P<0.05$) observed where male students were found to be more interested in solving problems compared to female students. The result was not in line with the hypothesis that female was expected to possess better learning attitudes than male students as more female students provided correct responses during classroom teaching. The parental intellect and their guidance can influence the achievement of students in solving problems Chala et al. (2020). Their ambition plays another key factor in aligning their interest in physics. Those students who aspire to take up a future career that needs a science background provide an extra effort in the science subjects.

The final set of findings shows a negative attitude in terms of understanding laws and concepts of physics, indicating that the students find it difficult to comprehend and explain the concepts of physics laws and theories, which was similar to the finding of Mbonyiryivuze et al. (2021). The participants responded that they memorize the equations and concepts that are difficult to remember. English being a second language, students must be finding it difficult to comprehend the laws and theories of physics.

The study gives a clear insight that students have a personal interest in learning physics. They expressed that they need to invest more time and effort to get the desired score. Students enjoy problem-solving, but they face difficulty understanding the laws, theories, and concepts of physics.

Limitations

Only 22 students from each class were included in the survey to represent the views of the whole class. Moreover, there are certain limitations when we collect data through surveys and interviews as they are based on personal interest based on the views expressed through their reflections (Ainley & Ainley, 2011; Hampden-Thompson & Bennett, 2013). However, the conclusion is made based on the views of 174 students included in the sample of the study.

Recommendations

The researcher made the following recommendations based on the findings;

1. Since students have a positive attitude toward learning physics, they need to be constantly motivated to perform better.
2. Teachers are recommended to use a variety of strategies and re-explain the topics that are related to the application of laws, theories, and concepts of physics as they face difficulties in understanding laws and concepts of physics.
3. Make use of simulations or ICT aids to explain abstract concepts, thereby increasing students' retention rate.
4. The researcher also recommends further study on the influence of attitude of students on problem-solving, the ability of students to relate physics to the real world, and understanding of laws and concepts of physics

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Conflict of interests

The author(s) declare no conflict of interest.

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