Unveiling Students' Perceptions of Effective Physics Instruction

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ABSTRACT: The main aim of this study was to explore secondary school students' perceptions of successful physics education and learning. The researchers employed a descriptive survey approach to attain this goal. A total of 55 tenth-grade students from two public schools in the Kathmandu and Lalitpur districts participated in the study. The researcher constructed a structured Likert-type questionnaire with a 4 -point scale as the instrument for collecting data. The reliability coefficient was calculated using Cronbach alpha and, following the instrument's validation, was revealed to be 0.84. The researcher used forms for questionnaires, and to assure 100 percent return, the questionnaires were then collected. The data was evaluated by the researchers by computing the mean, doing frequency distribution analysis, and determining the percentage of student replies for each item. In addition, the findings were compiled and gathered in order to answer the study question. The majority of students have a weak foundation in physics, according to some findings.

Introduction

Any country's ability to use science and technology effectively determines a great deal of its progress. Physics, one of the disciplines in science, is essential to technological progress since it has enabled the development of contemporary technology by applying its principles to new inventions (Chinyere, 2014). According to Adeyemo (2003), physics has the most fundamental concepts of all the sciences and is crucial to the growth of science and technology, which has an impact on people's daily lives.

Physics, as a branch of science, is critical in describing the events that occur in the universe as a whole. Physical principles and regulations may be found in everything that happens to us. Physics discoveries in the twentieth century were extremely effective in that they had a large positive impact on other important and helpful disciplines as well (Fishbein & Ajzen, 1977). Despite the fact that physics has a major influence on numerous facets of our life, national and worldwide studies show that physics education lags behind other subjects (Dieck, 1997; Gok & Silay, 2008; Mattern & Schau, 2002; Rivard & Straw, 2000). Nonetheless, knowing physics is critical for understanding the world, and physicists play an important role in increasing our nation's well-being and economic prosperity. The importance of understanding physics principles and achieving advances in the subject is a primary concern for many nations worldwide (Baran, 2016). However, various researches have demonstrated

that scientific achievement in this field is not promising (Aina, 2013; Aina & Philip, 2013). The subject is crucial, particularly in physics. According to Bamidele (2001), students' lack of passion for physics is due to their perception of the topic being difficult. Furthermore, their negative perceptions have an immediate impact on their performance in physics classes.

According to Aina and Akintunde (2013), students consistently performed poorly in physics at all levels of schooling, mainly because they found it highly challenging. Similarly, several researchers concurred that students' physics performance has been inadequate (Aigbomian, 1994; Aiyelabegan, 2003; Akanbi, 2003). According to Adeyemo (2010), the abstract nature of the course may have played a key role in this poor result. Due to the abstract character of the subject, physics education has not been successful in schools, which calls for the usage of instructional tools to help students learn the subject. Oladejo et al. (2011) emphasized that full knowledge of physics concepts is impossible to achieve without the appropriate use of instructional tools. Furthermore, low academic performance and drop-out rates point to secondary schools' inadequate capacity to produce graduates who are prepared for a vocation or university education (NIRT, 2016).

Numerous issues with physics education in schools were noted by the researcher in the context of Nepal. The educational system in Nepal is distinguished by its practice-based and teacher-driven approach, which places teachers at the center of the teaching-learning process (Koirala et al., 2020). Researchers in the field of physics have discovered that the majority of students in schools were uninterested in learning the subject, resulting in poor performance on final examinations (Semela, 2010). As proved by experience, the teaching-learning process significantly relies on teachers utilizing words to explain concepts and transmit facts. The researcher discovered a mismatch between the teacher's teaching style and the students' learning approaches in the classroom. A number of issues have been identified in this context that contribute to students' poor performance in science in general, and physics in particular. As a result, the study attempts to uncover the elements that contribute to the issue of physics teaching and learning in secondary-level schools in the metropolitan areas of Lalitpur and Kathmandu by understanding how students perceive physics concepts. Thus, this study aims to investigate and catalog the diverse perceptions and beliefs that students hold regarding the effectiveness of physics teaching and learning. To gain the aforementioned objective this study addressed the following research question:

What do students believe is the problem with effective physics teaching and learning?

Literature Review

Individual learners impact a substantial amount of the difficulties students have in grasping concepts in science. Students' perceptions on science, according to Bahar and Polat (2007), have a role in the challenges they confront with certain science concepts and topics, notably in the realm of physics. Nwona and Akogun (2015) also proposed that students face learning challenges that are related to their educational setting, previous knowledge, and study habits. They submitted that the cumulative effect of the factors listed above in addition to teacher and school environment factors could contribute immensely to the underperformance and low enrolment of students in many physics-related courses. The aforementioned viewpoints clarify the arguments made by Olatoye (2002), Ajayi (2007), and Adedayo (2008)

that students' underperformance in physics external examinations and poor enrolment in physics courses at the tertiary level may be connected to their perceptions of the discipline.

Physics education had long been a subject of research and debate, with a significant emphasis on understanding how students perceived and engaged with the subject matter. Effective physics instruction was essential not only for imparting knowledge but also for fostering a deep understanding and a lasting interest in the subject.

Previous studies consistently suggested that students benefited significantly from active engagement in the learning process, including hands-on experiments, collaborative group work, and problem-solving activities. For instance, Hake (1998) demonstrated that interactive engagement methods in introductory physics courses substantially improved student learning outcomes, creating an environment where students assumed responsibility for their learning and deepened their grasp of intricate physics concepts. Moreover, the literature consistently indicated that students held more favorable perceptions of physics instruction when it embraced student-centered principles. Student-centered methods in the teaching of Physics can be beneficial for students' enculturation into the discipline and into a physicist's profession (Sin, 2015). An essential aspect of student-centered learning entailed shifting from memorization to a focus on conceptual understanding (Redish, 2003). Traditional approaches, emphasizing the rote memorization of formulas and equations, obstructed students' ability to apply their knowledge to real-world problems. In contrast, a student-centered approach encouraged students to grasp the underlying principles and concepts, resulting in more profound and enduring learning outcomes. Additionally, the perception of assessment and feedback played a pivotal role in student-centered learning. Formative assessment techniques, including quizzes, peer evaluations, and self-assessment (Black & Wiliam, 1998), were integral to this approach. Students who received timely and constructive feedback on their performance were better equipped to adapt their learning strategies and enhance their comprehension of physics concepts.

Numerous studies have explored the pivotal distinction between conceptual understanding and rote memorization in physics education, with a consensus emerging that students who grasped fundamental physics concepts tended to excel and retain knowledge longer than those relying solely on memorization. (Redish, 2003) underscored the importance of nurturing a coherent mental framework for comprehending physics concepts. Conversely, rote memorization, which centered on memorizing formulas without deep comprehension, was associated with challenges in applying knowledge to real-world problem-solving (Etkina & Planinsic, 2015). Furthermore, instructional approaches emphasizing conceptual understanding fostered higher student interest and motivation, influencing their perception of physics as a subject and ultimately promoting sustained engagement and interest (Beichner et al., 2007).

Students' attitudes and beliefs about physics could greatly impact their learning experiences. One key aspect of students' attitudes is their motivation and interest in physics. A study by Wangchuk et al. (2022) explored the relationship between students' learning motivation and academic achievement in physics, finding that motivation is crucial for teaching and learning process for promoting meaningful learning. Similarly, Ugwuanyi et al. (2020) showed that motivation and self-efficacy had significant positive relationships with learner performance in Physics.

Methods

Research Design

The survey approach was used in the study to assess secondary school students' views of effective physics instruction and learning. A questionnaire was used to obtain the data.

Population of the Study

The study's target population was secondary schools in Lalitpur and Kathmandu. The population of the research was recruited at random from two public secondary schools in Lalitpur and Kathmandu.

Sample and Sampling Techniques

The study's sample consisted of fifty-five students from two secondary schools in Lalitpur and Kathmandu using simple selection at random procedures.

Research Instrument

A semi-structured questionnaire was used as the data collecting instrument to gain information on secondary school students' perceptions on effective physics teaching and learning. The questionnaire provided four response alternatives on a four-point scale: Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD), each weighted as 4, 3, 2, and 1. The questionnaires used in the study were fifteen in total, with five questions focusing on students' views of challenges in teaching and learning physics linked to student-related issues, another five on teacher-related issues, and the other five on miscellaneous issues.

Validity and Reliability of the Instruments

The questionnaires were evaluated by two Tribhuvan University professors from the departments of science education. They evaluated the instruments, made required revisions by eliminating, adding, and rearranging certain items, and guaranteed that the study questions were acceptable for improving the questionnaires' validity. The instruments' reliability was examined using Cronbach's alpha in SPSS version 20.0.0, obtaining a reliability value of 0.84.

Method of Data Collection

Before revealing the reason for the visit, the researcher presented themselves to the administrators, classroom teachers, and students at the selected schools. Following the introductions, the researcher told both the participants and the school administration of the reason for their visit. The researcher then randomly chose the number of learners and distributed the questionnaire to them by providing a brief instruction on how to answer each question. A fifteen-item questionnaire comprised of physics teaching and learning concepts was given to students to assist them in developing the scientific knowledge and abilities necessary for technological growth.

Results

SPSS version 20.0.0 was used to analyze the student data. The student's responses to each item were calculated, collated, and presented using frequency distribution analysis and percentages to answer the research question.

Question for Research

What do students believe is the problem with effective physics teaching and learning?

Table 1. *Students-related issues*

Students-related Issues	SA	A	D	SD	Mean	% of agreement	% of disagreement
Students' physics foundations are weak.	10	37	8	0	3.04	85.5%	14.5%
Students are psychologically afraid of physics.	15	32	7	1	3.11	85.5%	14.5%
Even with examples, physics issues are difficult for students to solve.	7	26	19	3	2.67	60%	40%
Currently, students have reduced levels of motivation to work hard.	7	18	19	11	2.38	45.5%	54.5%
Students do not try to solve their Physics challenges at home because of the lack of a tutor.	11	26	15	3	2.82	67.3%	32.7%

Table 1 presents the findings on issues affecting effective physics instruction and learning. The results indicate that a considerable majority of respondents agree on various issues: 85.5% of them agree that students have weak foundation in physics, and the same percentage agree that students are psychologically afraid of physics. Additionally, 60% agree that students face obstacles in solving problems in physics even with relevant examples given to them. On the other hand, 45.5% agree that students have reduced levels of motivation to work hard, while 54.5% disagree. Another concern was the lack of tutor, with 67.3% of respondents agreeing that it prevents students from finishing physics assignment at home. These findings suggest that, except for the students' perceived lack of motivation for hard work, all the listed factors were significant issues affecting physics instruction and learning.

Table 2. *Teacher-related issues*

Teacher-related Issues	SA	A	D	SD	Mean	% of agreement	% of disagreement
Physics subjects are not applied in the classroom to real-world situations.	6	26	21	2	2.65	58.2%	41.8%
Students' questions are not entertained by teachers.	3	20	28	4	2.40	41.8%	58.2%
Both the quantity and caliber of physics instructors in schools are insufficient	4	9	37	5	2.22	23.6%	76.4%
Physics teachers employ ineffective/conventional teaching approaches.	6	28	19	2	2.69	61.8%	38.2%
Teachers do not prepare their Physics lessons in a reasonable manner due to their enormous workload.	6	25	22	2	2.64	56.4%	43.6%

Table 2 above presents the students' perceptions regarding teacher related elements contributing to issues in physics teaching and learning. These perceptions are as follows: (6) 58.2% of participants believe that physics teachers fail to integrate theoretical concepts to real life situations, while 41.8% disagree. (7) 41.8% of respondents agree that teachers do not entertain student queries, while 58.2 disagree. (Aziz & Rahman) 23.6% of students agree that there is a shortage of sufficient caliber physics teachers in schools, whereas 76.4% disagree. (Aziz & Rahman) Respondents' agreement with teachers' inadequate teaching strategies was 61.8%, while disagreement was 38.2%. (10) A view on teachers not adequately planning for physics topics due to enormous workload receives a 56.4% agreement rating and a 43.6% disagreement rating. The finding indicated that, except for issues seven and eight, all the listed issues hinder the effective instruction and learning of physics according to the students' perceptions.

Table 3. Miscellaneous issues

Miscellaneous Issues	SA	A	D	SD	Mean	% of agreement	% of disagreement
Crammed classroom	6	17	27	5	2.44	41.8%	58.2%
a scarcity of educational resources	12	27	13	3	2.87	70.9%	29.1%
The lack of a library	1	16	33	5	2.24	30.9%	69.1%
The expense of providing physics education materials for children is out of reach for most parents.	0	9	33	13	1.93	16.4%	83.6%
Insufficient motivation	19	27	6	3	3.13	83.6%	16.4%

Table 3 summarizes the numerous aspects that influence secondary physics instruction and learning. These factors include (11) overcrowded classrooms, with 41.8% agreement and 58.2% disagreement among respondents; (12) a lack of teaching materials, with 70.9% agreement and 29.1% disagreement; (13) the absence of a library, with 30.9% agreement and 69.1% disagreement; (Aziz & Rahman) parents being unable to afford physics learning materials for their children, with 16.4% agreement and 83.6% disagreement; and (15) a lack of motivation, with 83.6% agreement and 16.4% disagreement. Except for items eleven, thirteen, and fourteen, the findings indicate that all of the concerns listed have an impact on the effective learning and instruction of physics as perceived by students.

Discussion

The research findings revealed that, although being a key subject in secondary science education, students were not fond of studying physics. The failure of secondary school students to comprehend the fundamental subject matter content, the principles of physics, has prompted this study to conduct research on how secondary level students perceive physics. These findings contrast those of Checkley (2010), Wenno (2015), and Mushinzimana and de la Croix Sinaruguliye (2016), who found that students have good attitudes and views of physics. However, they are consistent with the findings of (Ogunleye, 2009), Gimba et al. (2018), Akhter et al. (2019), and Mbonyiryivuze et al. (2021) who investigated students' opinions of challenges in effective physics teaching and learning.

As a result, this study examines students' negative perceptions about physics in terms of student-related issues, instructional strategies, and academic resources. These issues all contribute to students' challenges with physics learning. To solve these issues, it is critical to give adequate time and chances for every student to interact with physics topics as they are being taught.

Conclusion

The research findings indicated that students have inadequate physics foundations from earlier grades, lack dedication and excitement for learning, and come across adverse teaching and learning situations. Furthermore, a significant number of physics teachers have limited teaching credentials, and many fail to appropriately plan for their sessions owing to extreme workloads. Physics instructors must be regularly trained to prepare their students for the difficulties of the twenty-first century and worldwide competition in their chosen areas. Furthermore, physics teachers might aim to tie their teachings to real-world scenarios to improve educational pedagogical techniques.

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