



My Reflexivity on Pedagogical Practices of Physics Teachers

Pankaj Sharma Ghimire
New Millennium College, Kathmandu, Nepal

✉ Corresponding author
(pankajghimire1975@gmail.com)

Abstract

This paper aims to elaborate my reflection on the instructional practices of physics teachers in theory and experimental classes at technical institutions in the Kathmandu district. I employed an ethnographic research design to conduct the research. I selected two technical institutions in the Kathmandu district to conduct the research, two theory classrooms, and two physics laboratories of those institutions for the participant observation process, and conducted open-ended and unstructured interviews with nine students from those institutions. I observed multiple theory and experimental classes for the entire semester period as a complete observer. In addition, I employed social constructivist learning theory to guide the whole research process. The findings from this study indicated that traditional teacher-centric pedagogical practices were prevalent at those technical institutions.

Keywords: *ethnographic research design, technical institutions, social constructivist learning theory, teacher-centric*

Article info:

Received 17 March 2024; Accepted 26 April 2024; Published 15 May 2024

INTRODUCTION

I completed my master's degree in physics in the year 2001 and joined a higher secondary school as a physics teacher whose prime responsibility was to conduct the theory and experimental classes for grade 11. The administration of the institution where I joined as a novice teacher didn't provide me classes for grade 12 as they might have thought that I was not enough experienced to handle the duties and responsibilities, so they asked me to take classes for grade 11. I worked in that institution for almost a year and then left the institution and returned to Kathmandu in search of lucrative positions in the educational institutions.

After a minor struggle for 2 months, I got a job as a physics teacher in a technical school. This was the beginning of my job as a physics teacher in a technical school. The academic head of the institution appointed me as a physics teacher whose responsibility was to conduct theory and practical classes for the diploma in engineering students. It was July of 2002 when I formally started teaching in a technical institution. This technical institution was an engineering school in which my first batch of students were from civil, computer, and electronics engineering streams.

In my two decades of teaching practices in this technical school, my chief responsibility was to conduct theory and experimental classes for the first-year engineering students. During this period, I did the same as recommended by the curriculum designed by the so-called expert team of the Council of Technical Education and Vocational Training (CTEVT). My pedagogical practices were guided by the notion of banking education (Freire, 2005) and the Chalk talk (Brookfield, 2005) approach. I started a topic, derived equations/ formulas, and most importantly employed a 'guided laboratory approach' (Ghimire & Shrestha, 2023; Wilcox & Lewandowski, 2016) in physics laboratory teaching. I was focused on the predetermined outcomes of the set of problems and experiments.

My professional life in this technical institution spanned over 20 years and it came to an end in April 2022. I had to resign from the post of physics teacher as I was very much concerned with my M.Phil dissertation in which I had to collect data for a relatively longer period. After two decades of teaching practice at several institutions, I decided to join Kathmandu University, School of Education to pursue my higher education in the field of Education as I wanted to explore and investigate the issues, opportunities, and challenges in the Nepalese science/ physics education landscape. I joined the M.Phil (Master of Philosophy) program in Education which is a research-based 1.5 years (a three-semester) course. In the third semester of the coursework, the supervisor provided me with the title of my dissertation which was, "Teaching and Learning Practices in Physics Classrooms of Technical Schools in Kathmandu: An Ethnographic Inquiry." (Ghimire, 2023)

Below I present the reasons why I opt for higher education in the field of Education.

During my two decades of teaching practices in a technical school, I found my students complaining about physics. Most of the students claimed that physics was a difficult subject discipline (Angel et al., 2002) and that they found it hard to grasp many theoretical principles. Still, most importantly it was very annoying for them to solve numerical problems as well as conceptual understanding related to several theories based on the curriculum of diploma in engineering.

In addition to this, I noticed that most of the students lacked science process skills especially integrated science process skills such as the ability to identify variables, make operational definitions, form hypotheses, design and conduct experiments, and finally draw conclusions. (Darmaji et al., 2019). Also, I realized that the teaching practices inside the theory and experimental classes were guided by the notion of transmission-based pedagogy (Acharya, 2016) which might have played key a role in the academic achievement of the students as I noticed that many students failed to succeed in their final examination.

Moreover, I noticed that many students in the physics final examination were unable to secure good grades or even pass marks. The final examination grades disappointed me even though I truly engaged myself in the teaching process. Even after teaching for many years, I was not able to improve the grades of my students which prompted me to opt for learn something different related to physics pedagogy so I joined the Master of Philosophy in Education to learn innovative pedagogical approaches and to tackle several educational issues in the context of the Nepalese Educational landscape.

I chose ethnography as a research design because this design is used to study groups in education, their behaviors, beliefs, and language (Creswell, 2012). Moreover, this specific research design is used for describing, analyzing, and interpreting culture-sharing groups. I wanted to dig deep inside the culture of teaching physics in the technical schools in Kathmandu Nepal. In addition, I wanted to immerse myself in an in-depth understanding of that culture. Ethnography shares a common objective, which is for a researcher to gain insight into the lived experiences of a particular group and subsequently articulate and interpret those experiences for those who are not affiliated with that group. This particular form of research entails a significant level of involvement and interpretation.

In addition, I chose ethnography as one of its key characteristics is the researcher's reflexivity which enabled me to elaborate on the pedagogical practices of physics teachers since my learning journey, myself as a physics teacher who taught at several institutions in Kathmandu district, and the teaching practices of the physics teachers in the technical schools of Kathmandu district. The term "reflexivity" in research refers to the researcher's awareness of and candor about his or her involvement in the study in a way that respects the study location and research participants (Creswell, 2012) and I constantly examined my own perspectives regarding the topic of study by engaging in reflexive practice (Gullion, 2016). Through reflexive engagement, I wanted to dig deep into teachers' pedagogical practices in the culture of teaching and learning physics. In addition, I thought that ethnography would enable me to collect data through the lens of a researcher as compared to other qualitative research designs. Based on the ethnographic design I observed several classes that included theory classes as well as experimental classes.

This paper aims to reflect upon the pedagogical practices of physics teachers in technical institutions. This reflective paper is guided by the following overarching research question; What are the pedagogical practices of physics teachers in theory and experimental classes?

Theoretical Framework

The theoretical underpinning of my research is social constructivism. According to social constructivism, cognitive growth develops at the social level and then individual level. Knowledge as a human product that is socially and culturally constructed. Social constructivism emphasizes learning and learners as the heart of the educational process rather than teaching and the teachers. Moreover, this learning theory stresses on teacher as a facilitator or guide (Taylor, 2014), not as a dictator. The teachers are supposed to provide support to the learner in the first step and then the learner will start learning independently. Learning theory plays an important role in better learning outcomes as well as the cognitive development of the learners. I believe that social constructivism plays a crucial role in the meaningful learning process.

Taylor (2014) asserts that social constructivism perspectives recommend science teachers to carry out learning activities in the context of students out-of-school lives to enhance the meaningfulness of learning science. It focuses on the fact that students should be engaged in learning in collaboration with small groups or within the whole class level. In doing so, students learn to construct meanings from what they learned in collaboration and develop a pattern of discourse with their peers and teachers. Adams (2006) argues that social constructivism emphasizes the intricate relationship between teaching and epistemology. The social constructivist pedagogy requires a reappraisal of the learner- teacher relationship. Also, the emphasis on learning keeps learners in the cardinal position. Akpan et al. (2020) suggest that social constructivism is a learning approach based on the collaborative efforts of learners through interaction, discussion, and sharing of knowledge among learners. The teachers' role is to employ the learners' centric approach to instruction.

Also described as Interpretivism, social constructivism can be defined as a worldview in which learners attempt to comprehend the world they live in through the lens of their own experiences (Creswell, 2013; Denzin & Lincoln, 2011; Mertens, 2010; Schwandt, 2003 cited in Boyland, 2019). In addition, the social constructivist philosophy directs science education researchers to go for ethnographic research methods that require prolonged observation, non-clinical interviewing, emergent analysis through grounded theorizing, and thick description. (Taylor, 2014). These qualitative methodologies allow researchers to develop a deep grasp of the perspectives that shape the meaning of interactions between teachers and students in the classroom.

The social constructivist principles also influence the data collection as the participant observation was carried out in four different classes in theory and practical sessions in which students were supposed to play a key role in the knowledge construction process. In this environment, knowledge is created by interactions of individuals and the influence that one individual has over another individual (Boyland, 2019).

During my many years of teaching practices in a technical school and other higher secondary schools, I noticed that the instructional practices were not in line with the social constructivist principles. Social constructivist principle assumes learning and learners at the heart of the educational process. However, on the contrary to this, almost all the classes were run under teacher-dominant pedagogy in which teaching, rather than learning, was kept in high priority. For instance, learners must comply with the teacher's notes and lectures. Learners were prepared for the final examination through the set of previous year's question collection. Moreover, a cook-book culture in the physics laboratory learning prevailed. In this way, the learning process was best sidelined and worst ignored.

RESEARCH METHODS

I employed a qualitative approach in educational research which is used for the study of natural social life (Saldana, 2011). In addition to this, I utilized ethnographic design in the research process. I typically employed educational ethnography as it has an intensive history of more than three decades in several institutions around the world (Gordon et al., 2001). In this paper, I have reflected on what I saw and heard in the observation settings. Gold (1958, as cited in O'relly, 2005) describes four positions of observation in ethnography which are participant as observer, observer as participant, complete observer, and complete participant. I have chosen the third option in which I didn't participate in the class, rather my role was of a complete observer. I carefully noticed the teachers' pedagogical practices in the theory and experimental classes.

Research site and participants

I chose two engineering schools as the research sites to conduct this research. The first institution was a polytechnic institution whereas the second one was a mono-technical institution, and both were affiliated with the Council of Technical Education and Vocational Training (CTEVT) board of the Nepal government.

I preferred the purposeful sampling technique to select the participants and chose nine students for the interview process from first-year diploma engineering. I gave pseudonyms to the students such as Binil, Rajendra, Neha, and Himalaya from institution A and Bikash, Ramesh, Suren, Asmita and Nischal from institution B. I selected two physics teachers as my research participants for the observation classes to be carried out. I selected four different classrooms to observe the settings. Also, I selected two theory classrooms and two laboratories of the desired institutions. In the theory class of Institution A, there were 20 students whereas in Institution B there were 30 students. Likewise in experimental classes, different groups of students were observed.

Students enrolled at both institutions were originally from different parts of Nepal. Some participants were from rural areas, and some were from urban areas of different parts of the country. The research participants majority were male while the female participants' presence was small as compared to their male counterparts. The prior educational background of most of the participants was from government high schools. Most of them had completed their Secondary School Examination (SEE) from government-based schools. Few of them completed their SEE from private English medium institutions.

Likewise, the teachers were both experienced in terms of their involvement in those technical institutions. The teacher from institution A had been teaching physics for the last 15 years and that from B had been teaching physics for the last 11 years. Both completed their master's degree in physics from Tribhuvan University, Kathmandu Nepal.

Data collection strategies

I employed two approaches to data collection. The first one is the main method of ethnography (O'Reilly, 2005) called participant observation in which I observed several classes throughout the first-semester coursework of physics and the second one is interviews with the participants.

To collect the field notes I had a separate notebook and a ball pen. Each time I entered the theory and practical classes I was surrounded by the students and I carefully observed their action, reaction and interactions and noted all those phenomena in my notebook. I also noted the teachers delivering lectures on topics such as principle of reversibility of light, real and apparent depth, total internal reflection of light, gravity, gravitation, simple harmonic motion, and many more. I gathered abundant amounts of field notes through participant observation in theory as well as practical classes at both technical institutions. I couldn't record the classroom observation through my cell phone as I thought that it could be the case of unethical practices in educational research.

As far as the interviews are concerned I approached several students for the interview process but some of them denied thinking that the researcher might disclose all the conversations with the school administration. Finally, nine students from both technical institutions agreed to my request to take part in the interview process. I conducted open-ended and unstructured interviews with those students. Most of the interviews were conducted face to face while a few were conducted online such as the Zoom platform. I recorded all the interviews in my cell phone drive and transferred it to my personal computer for further reference as I thought that if my cell phone were lost then it would place me in a difficult situation. So it was a prime responsibility for me to protect the data collected from the interviews.

In addition, I prepared the participant observation guidelines together with the interview guidelines so that the two approaches of data collection lie within the domain of those guidelines. Interview questions were also developed based on which the participants were asked the questions. However, in some cases, the conversation with my research participants went beyond the prescribed questions.

Data analysis

Data analysis enabled me to pursue the answer to the research questions which I think is a central step in qualitative research. The analysis of the data ensures the outcome of the research (Flick, 2014). Since the data that I collected was based on interview and class observation, the cardinal step after data collection was to analyze those interview excerpts and the field note transcripts.

I had already abundant data related to class observation. The only challenge for me was to transcribe the interview transcripts. All the recorded interviews were put into words in separate note book. Then I prepared two different code books for observation and interviews. I coded the field notes and the interview transcripts. Several codes were developed from both aspects of data collection primarily by employing the N vivo coding (Saldana, 2011). Some of the codes from observation were; *The teacher starts a topic, The teacher explains the diagram, the teacher provides an example, teacher employs calculus* and codes from interviews were; *teacher comes, explain and provides notes, He don't connect with real life issues, teacher unilaterally derives the topic,* From the code books, I generated some categories such as *teacher explains, teacher derives formula, text-book supplement, students do not copy, teachers' rude behaviour, teacher scolds etc.* In addition, I had also prepared the observer's comment (Saldana, 2011) on what I heard and saw during my participant observation in the theory and experimental classes at those institutions. I analyzed the observer's comment coding and categorizing those comments. Some of the codes were, *preparing for exams, skipping chapters, teaching very quickly, not letting students for the reply, not discussing with students, not posing questions to students.*

Finally analysizing the fieldnote excerpts, interview transcripts, and my personal comments on the phenomenon I developed some themes such as *lecture-based instruction, class note oriented instruction, Exam-centric instructions, cookbook instructions in physics lab, lack of active instructional practices.*

Ethical considerations

I eagerly awaited the opportunity to attend physics teachers' lessons as an observer, sitting among the students. To do this, consent was a must. In this sense, I had to obtain consent from the concerned administration of the institutions under investigation. Moreover, I had a prime responsibility of protecting the rights (Murphy & Dingwell, 2001) of my participants.

First, I talked with the administrators of both technical schools and explained them about my research. They provided me with the consent to conduct the research in their respective institutions.

Again, I talked with the physics teachers and the students about my research. I put forth several educational issues in Nepal, especially in physics education of diploma in engineering curriculum. I requested my research participants to take part in the research as this research could reflect the outcomes of teaching practices inside the theory and experimental classrooms.

My research participants agreed to my request to participate and become an integral part of my research. Moreover, they encouraged me to do the research and said they would fully support me in this endeavor.

In this way, I obtained consent from three major stakeholders namely the schools' administration, the students, and the physics teachers.

RESULTS AND DISCUSSION

Lecture-based Instruction

During my participant observation in institution A, I noticed that teaching and learning were carried out for the branch of physics called optics. The teacher taught several topics such as principle of reversibility of light, lateral shift, real and apparent depth, total internal reflection of light, reflection at spherical surfaces which the teacher taught two principle spherical mirrors called concave and convex mirrors and so forth.

Likewise in institution B the teacher taught several other topics such as simple harmonic motion, Characteristics of SHM, simple pendulum, gravity and gravitation, variation of acceleration due to gravity, and many more.

The Units of the curriculum and the topics taught at those technical institutions were entirely different. I carefully observed that the teaching and learning in Institution A was carried out for the unit optics while it was carried out for the unit mechanics in Institution B.

In both institutions, the primary pedagogical approach was lecture-based teaching which was also verified by the nine students during the interview process. The participants of the study said that their teachers dealt with the topics by deriving the formulas and equations, explaining them, and providing examples.

During my learning journey at the intermediate level of science, my instructors used lecture-based methods to teach physics. Back then, the physics teachers would come up with formulas and give us a one-sided explanation of the theory; we had to either replicate their notes or pay attention to them. As a result,

we the students of that class were regarded as the passive recipients (Emalia, 2017) of content knowledge as delivered by the teachers.

For over 20 years, I taught two units per semester at a technical school. Magnetism and mechanics were those units. Completely distinct contents were implanted in both units. However, I was also influenced by the lecture-based approach to teaching that I saw in those technical institutions in participant observation settings.

Both institutions' curricula were heavily weighted toward lecture-style instruction. From what I observed, instructors covered a wide range of subjects and arrived at equations and formulas by drawing diagrams and using geometric and other mathematical techniques. I observed that teachers were busy explaining the aspects of the phenomenon I felt that it was like a one-way traffic (Ghimire & Luitel, 2024). I noticed that many students were disinclined in the learning process as some of them were talking to their friends and making noises, and some were playing with their phones and making fun of each other. Being an experienced physics teacher and an educational researcher, I realized that the teachers could not make the teaching interesting as there was a lack of 'rich inquiry-based dialogue' (Taylor, 2014) in the teaching and learning process. The teaching entirely seemed to be an act of depositing (Freire, 2005) into the seemingly empty minds of students (Taylor, 2014).

Class-note centric instructional practices

During my observation sessions at Institution A, the learning culture was such that I noticed additional books on the students' desks, and every student had one. I noticed that all of the students had opened the supplement book in front of them and were listening to the teacher. The majority of the children did not duplicate what the teacher was writing. In truth, they were trying to match the contents of the supplement book to the teacher's write-up on the whiteboard. It appeared to me that the teacher stressed the theoretical section of physics, which comprised both lengthy and short answers, from that specific book rather than others, as I did not notice any pupils carrying the CTEVT suggested books. Students were drawn to the text-book supplement since it exclusively included exam-related themes and questions.

Even though the college had advised them to study physics through books, students at institution B were completely reliant on their teachers' notes. As I could see, all of them were copying the teacher's write-up while the teacher was explaining the topic through principles and formula derivation. While several of them had books on their desks, I noticed that they were occupied with copying the teacher's notes from the whiteboard. I can state with confidence that the main goal of this lesson was to have the students replicate the teacher's writing in order for them to understand the material that the teacher covered.

In addition, participants from Institution A disclosed that they learned the theoretical portion of physics from the teacher's generated note which was a supplementary book. On the other hand, participants from institution B claimed that they learned the theory part of physics from the teacher's write-up that they copied from the whiteboard.

In my professional life, I have seen that physics students rarely carry textbooks. For this purpose, a few of them used the library, while most of the students relied on notes. They may have believed that copying the teacher's outline was the ideal approach to learning physics and get ready for the final exam. I used to conduct lectures in a technical school in the same manner as the instructors there when I was a teacher there. In addition, I had instructed my pupils to replicate my handwriting in their own notebooks, which was consistent with the teacher's role model image of an authoritative leader. Fadaei (2021) claims that the primary goal of science teachers is to allow students to think and act like scientists rather than just learning or copying what others have already done.

Instead of teaching students through social interactions, the physics teachers at both technical schools forced the students to learn through specific instructional materials, like textbook supplements and teacher-generated class notes. The teachers' role seemed to override the importance of learners and learning, the heart of the educational process (Adams, 2006), thus treating the learners as a machine undergoing several cycles of programming and reprogramming.

Exam-centric Instructional practices

During the participant observation classes in institution A, I noticed that the teacher emphasized exam-related questions and he repeatedly stressed the following statements,

“These conditions will be asked in examinations.”

“This chapter is very important as it could be asked in the form of numerical question and/ or theoretical long question.”

“You should remember the geometrical elements. If you don't use those terms properly then the examiner will deduct your marks in the final examination.”

The scenario of this class seemed to be an examination-oriented class in which the teacher focused on the chapter/topic that was considered the so-called important questions for the exam. I was surprised to see him focusing on students to prepare for the final examination and not encouraging them to learn what he taught in previous classes or in that class.

In Institution B I again noticed similar things that I did in Institution A. The teacher during his teaching stated several times through the following statements,

“We studied Newton's second law of motion in the translational dynamics portion and this portion is the counterpart of Newton's second law of motion in rotational dynamics so in examination, the question might be asked about the rotational counterpart of Newton's second law of motion.”

“This topic could also be asked in this way. Deduce a formula connecting the torque, and moment of inertia or it could be asked to connect the relationship between torque and angular acceleration. In either case you should write the same answers.”

In both institutions, the culture of teaching was such that teachers emphasized the preparation for the final examination. Teaching was limited to covering the curriculum alone and was intended to glean the optimum marks to pass the examination and secure better academic achievements.

The participants at both institutions claimed that teachers stressed the important questions to prepare for the final examination and suggested the students carefully study the chapters and topics for the exam. Moreover, teaching practices were aligned towards exam-focused teaching as all of the participants from both institutions echoed about preparing the old set of questions from the question bank.

Likewise, throughout my professional career, I also implemented the idea of tackling a set of previous exam questions since I believed it may improve students' learning and academic performance on the final exam. I limited the scope of my students' learning experiences by making it mandatory for them to complete every question in the book of past exam questions. My primary goal was to get them ready for the final exam and earn better grades, which would enhance my credibility as a teacher and the reputation of the academic institution where the teaching and learning took place.

Exam-oriented education, which places a strong emphasis on evaluating student proficiency through exam results to separate the minority from the majority (Chen & Zou, 2018) and send them to a higher level of education, encompasses both my own learning and teaching practices as well as the practices of the two technical schools.

Exam-centric education puts students under a great deal of stress because it views exams as a way for them to demonstrate their worth. Moreover, such an educational approach acts as a repressive force in a person's social and academic life. (Kirkpatrick & Zang, 2011).

Cook-book/ Expository instruction in the physics laboratory

During the observational classes inside the physics laboratory of institution A and B, I observed that the teachers focused on the laboratory manual as a cardinal instructional technique in teaching the experimental physics curriculum.

I noticed that the teachers were scrutinizing the lab manuals of the students and assigning grades based on their performance in attaining the desired answer for each experiment. The laboratory manual was an important tool for instruction in laboratory teaching.

When I looked in detail over the manual, I discovered that there were ten experiments. A teacher from both technical colleges created the manual. When I opened the lab manual, I saw numerous things embedded inside it. These experiments were conducted throughout the semester's coursework. In addition, there were tables and other blank spots provided for students to fill in the data obtained from the instrument and perform calculations using the conventional methods.

When I was an intermediate-level science student, my physics lecturers told us to buy a sheet of paper known as a physics practical sheet and a recommended experimental textbook. Furthermore, my teachers instructed us to duplicate the full piece of an experiment and paste it onto the physics practical worksheet. We were directed through direct supervision using traditional instructional procedures.

In my professional career as a physics teacher at numerous institutions, I used the same method of instruction in the physics laboratory that I was guided through my learning journey.

The majority of the participants in my research were students, who had a common perspective on the lab manual because they used it as a primary learning tool. They went on to say that they used particular tools to gather the data, entered it into a table included in the lab manual, and then calculated the results to obtain the targeted predetermined values.

As a researcher, I assert that teaching through lab. manual at both technical schools possessed numerous restrictions for students such as exploring other experiments they wanted to investigate what they learned in their theoretical physics classes and avoiding the discussion-based strategy of collecting the information through several sources.

Lack of active instructional practices

Active instructional approaches such as inquiry-based learning, project-based learning, problem-based learning and discovery-based learning (Pokherel, 2022) have their roots in constructivist learning theory. Active learning emphasizes the importance of cooperative efforts, teamwork, and exchanging skills and ideas. This learning paradigm strictly focuses on learners-centered instructional approaches in which the teacher should act as a facilitator or guide (Taylor, 2014) rather than an authoritarian leader.

However, the scenario in which I as a teacher and the other two physics teachers under study sharply contrasted with what the active learning theory proposes. During my teaching journey I didn't employ the active learning approaches, and neither did I observe such instructional practices in the technical schools where my research was conducted. During the participant observation classes at both technical schools, I saw that the teachers were teaching at a fast pace, there were no interactions between students and teachers, and teachers skipped some topics, and only focused on those which appeared in the previous final examination. Moreover, teachers tried to skip students' concerns regarding the topic they were teaching.

My research participants from both technical schools also put forth their comments on teacher's pedagogical practices. Out of nine research participants, some of them criticized the teacher's pedagogical practices. Himalaya from Institution A and Bikash from Institution B contended that the teachers prioritized course coverage over student engagement. Nischal from institution B stated that he found physics challenging due to a lack of comprehension of the teacher's lesson. He asserted that teachers used English as the language of instruction and delivered their lessons. rapidly. Coming from a Nepali medium school under the government, he expressed difficulty in comprehending English. Moreover, Neha and Himalaya from institution A claimed that their teacher taught fast due to which it was difficult for them to understand the theories or examples.

Likewise, students also shared their views regarding interactions in the classrooms. Most of them claimed that there were almost no interaction between teacher and students in the classrooms.

According to Bikash, Suren, Neha, Binil, and Ramesh, there were no discussions or other forms of academic interaction taking place in the classrooms. Rajendra asserted that there weren't many interactions in the classroom, though. According to Asmita, the teacher asked brief questions and didn't let students respond, instead, he provided his response. Neha and Bikash also mentioned that teachers disagreed and questioned what he was teaching. Bikash contended that the instructor ignored his concerns and asked for a meeting for the following day or after the class. Neha reported that she was told by her teacher not to pose questions without context.

Discussion

The observed instructional practices in technical schools seem to contradict the principles of social constructivism which emphasizes students-centric pedagogy and active engagement. For instance, while social constructivism advocates the learners to construct their own knowledge through interaction and exploration the observed instructional practices position teachers as the primary disseminators of knowledge thus limiting the opportunities for dialogue-based learning and critical thinking. The findings are not in line with the theoretical framework described by Akpan et al.(2020), Taylor (2014), and Adams (2006).

The primary instructional method is lecture-based popularly known as the chalk talk (Brookfield, 2005). While lecture-based instruction is well known for spreading knowledge, it is less effective at stimulating students' curiosity and promoting in-depth understanding (Dacre & Fox, 2000). Lecture-based instruction is a method for delivering a substantial amount of information to a diverse student population. However, it does not significantly contribute to cultivating the advancement for lifelong learning, a vital competency for individuals operating in dynamic and ever-changing domains (Ahmed & Roy, 2014). The findings of my research are consistent with the research conducted by Worku and Alemu (2021) who assert that teaching and learning in physics classrooms were carried out by reiterating content from earlier lessons, providing definitions of terms, describing the relationship between physical quantities using mathematical equations, and solving numerical problems. In addition, the findings also revealed that the teachers' focus was on simple implementation of centrally produced curricula and objectives (Brookfield, 2005) which indicates teachers as both source and transmitter of knowledge (Yesilyart, 2022) as in teacher's centric pedagogy.

The findings related to exam-centric instruction were in line with Meng et al., (2021) who assert that the primary objective of exam-centric education is to unilaterally develop students' capacity. Likewise, the findings are also consistent with Mackatieni (2017) who asserts that educators employ non-scientific pedagogical methods to improve students' academic outcomes, thereby creating a tense, frantic, and competitive environment within primary and secondary educational institutions, thus augmenting students' academic burden. The researcher emphasized the learners deeply review the previous set of final exam questions to accurately replicate the material they have learned in regular lessons.

The restrictions in physics laboratories at both technical institutions showed that the lab activities carried out were examples of traditional guided laboratory activities (Ghimire & Shrestha, 2023; Wilcox & Lewandowski, 2016) popularly known as expository or cook-book laboratories (Fadaie, 2021). The expository method is a method of instruction that is centered on a teacher (Nnorom, 2016). This type of laboratory instruction has been the dominant laboratory educational approach for decades in which little emphasis is placed on critical thinking and conceptual shift (Clark et al., 2015). Likewise, Fadaie (2021) and Ural (2016) claim that such type of instructional styles dictate to students what, how, and when to think. The consequence is that the laboratory learning benefits are largely lost. Moreover, the researchers argue that this type of laboratory instruction has its roots in the predetermined outcomes thus allowing students to follow the directions in the laboratory manual step by step. Learners follow instructions rather than engage in questioning, designing, conducting, and analyzing. Expository environments prioritize lower cognitive skills such as rote learning, algorithmic problem solving, recall and rule application while ignoring higher-level thinking skills such as investigation, planning, and result interpretation (Domin, 2007).

Given the predominance of lecture-based, expository/cookbook together with the exam-centered instructional practices observed in the technical schools there is a clear need for pedagogical interventions aimed at promoting more student centered approach to teaching physics. For instance, professional development workshops could be organized to train teachers for active learning approaches such as inquiry-based learning and project-based learning for theoretical physics and experimental physics portions respectively. Amador (2019) proclaims that active learning enhances academic performance and fosters student engagement through questioning, sharing of ideas, and critical thinking.

During my learning journey in M.Phil program, I went through inquiry-based as well as project-based learning in detail. I developed a project work for both students and teachers and an inquiry-based curriculum to demonstrate the concept of 'Energy' for diploma in engineering first semester course work. Being a learner and an educator guided by conventional teaching and learning practices in my learning and professional journey and an educational researcher advocating for active learning approaches, I realized that implementing such instructional approaches could not only improve student learning outcomes but also contribute to a more dynamic and engaging atmosphere of learning physics.

As a lead researcher in this study my own background as a physics teacher in technical schools may have influenced how I perceived and interpreted the observed pedagogical practices. Having been immersed in the culture of lecture-based and exam-oriented pedagogy during my professional journey, I may have been predisposed to view these practices through a certain lens. However, through constant reflection and engagement through reflexive practices, I strived to open to alternative perspectives and acknowledge my own biases in shaping the research process. By recognizing and addressing my positionality as a researcher I aimed to enhance the credibility and validity of the research findings.

Every research has its own limitations. In the context of my research, the possible limitations might be the number of technical institutions selected for the research. If I had selected more than two technical institutions the research findings could have been more refined. My research was mainly concerned with the teaching practices in engineering schools which is a sub-division of technical institutions in the context of technical education in Nepal. I didn't include other technical institutions such as forestry, agriculture, health science and so forth. I wasn't able to conduct research in all these educational institutions owing to the lack of time and the length of the dissertation.

CONCLUSION

The findings from this study shed light on the pedagogical practices of physics teachers in the technical institutions of Kathmandu Nepal. The findings from this study suggested that traditional instructional practices such as lecture-based instructions, materials-oriented instructions, and exam-centric instructions as well as lack of active instructional approaches prevailed at both institutions. These instructional practices are commonly known to be traditional teacher-centric pedagogical practices. Based on the findings from this research I assert that the transmissive nature of the pedagogical practices in the context of the Nepalese educational landscape might be responsible for the poor academic achievement of students together with the lack of science process skills in laboratory learning.

ACKNOWLEDGEMENTS

This research is based on my M. Phil dissertation project. I would like to thank my research supervisor, and the course facilitators who assisted me during my learning journey at Kathmandu University, School of Education. My profound gratitude goes to all the research participants, especially the students of diploma in engineering, the concerned administrative section, and finally the physics teachers of both technical institutions for their necessary support thus creating a conducive environment for my research endeavor.

REFERENCES

- Acharya, K. P. (2016). Fostering critical thinking practices at primary science classrooms. *Research in Pedagogy*, 6(2), 1-7. <https://dx.doi.org/10.17819/2015.30>
- Adams, P. (2006). Exploring social constructivism: Theories and practicalities, education 3-13: *International Journal of Primary, Elementary and Early Years Education*, 34 (3), 243-257. <https://doi.org/10.1080/03004270600898893>
- Akpan, V.I., Igwe, U.A., Mpamah, I.B.I., & Okoro, C. O. (2020). Social constructivism: implications on teaching and learning. *British Journal of Education*, 8(8), 49- 56.
- Amador, J.A. (2019). Active learning approaches to teaching soil science at the college level. *Frontiers in Environmental Science*, 7, 111. <https://doi.org/10.3389/fenvs.2019.00111>
- Angel, C., Guttersrud, O., Henriksen, E.K., Isnes, A. (2002). Physics: Frightful, but fun. pupils and teachers' views of physics and physics teaching. *Journal of Science Education*, 1-25. <https://doi.org/10.1002/sce.10141>
- Boyland, J.R. (2019). A social constructivist approach to the gathering of empirical data. *Australian Counseling Research Journal*. www.acjournal.com.au
- Brookfield, S. D. (2017). *Becoming a critically reflective teacher*. Jossey-Bass
- Chen, R., & Zou, M. (2018, December). Discussion on the Relationship between Exam-oriented Education and Quality-oriented Education. In *2018 2nd International Conference on Education Innovation and Social Science (ICEISS 2018)*, 350-353.
- Clark, T.M., Ricciardo, R., & Weaver, T. (2015). Transitioning from expository laboratory experiments to course-based undergraduate research in general chemistry. *Journal of Chemical Education*. 93. 56-63. <https://doi.org/10.1021/acs.jchemed.5b00371>
- Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Pearson Education, Inc.
- Darmaji, D., Kurniawan, D.A., & Irdianti, I. (2019). Physics education students' science process skills. *International Journal of Evaluation and Research in Education*, 8(2), 293-298. <https://doi.org/10.11591/ijere.v8i2.28646>

- Domin, D. (2007). Students perceptions of when conceptual development occurs during laboratory instructions. *Chemistry Education Research and Practice*. 8(2). 140-152. <https://doi.org/10.1039/B6RP90027E>
- Emaliana, I. (2017). Teacher-centered or student-centered learning approach to promote learning. *Journal Social Humaniores*. 10(2), 59-70
- Fadaei, A. S. (2021). Comparing the effects of cookbook and non-cookbook based lab activities in a calculus-based introductory physics course. *International Journal of Physics and Chemistry Education*, 13(4), 65-72. <https://doi.org/10.51724/ijpce.v13i4.135>
- Freire, P (2005). The banking concept of education as an instrument of oppression. In Ramos, B, M, & Macedo, D(Eds), *Pedagogy of the oppressed* (pp.71-86), The continuum.
- Ghimire, P.S., & Luitel, B.C. (2024). Exploring Teaching and Learning Physics in Engineering Institutions of Kathmandu District. *KMC Journal*, 6(1), 40-56. <https://doi.org/10.3126/kmcj.v6i1.62327>
- Ghimire, P.S., & Shrestha, K. (2023). Traditional guided lab activities in the physics laboratory of engineering institutions in Kathmandu district of Nepal. *Universal Journal of Educational Research*. 2(4), 325-333. <https://doi.org/10.17613/0w15-v708>
- Gordan, T., Holland, J., & Lahelma, E. (2001). Ethnographic research in educational settings. In P. Atkinson, A. Coffey, S. Delamont, J. Lofland, & L. Lofland (Eds.), *Handbook of ethnography* (pp. 188-203). Sage publications
- Gullion, J.S. (2016). *Writing ethnography*. Sense publisher
- Kirkpatrick, R., & Hlaing, H. L. (2013). The Myanmar university entrance examination. *Language Testing in Asia*, 3(1), 1-15.
- Murphy, E., & Dingwall, R. (2001). The ethics of ethnography. In P. Atkinson, A. Coffey, S. Delamont, J. Lofland, & L. Lofland(Eds.), *Handbook of ethnography* (pp. 339-351). Sage publications.
- Nnorom, N.R. (2016). Effect of Investigative laboratory approach and expository method on acquisition of science process skills by biology students of different levels of scientific literacy. *African Journal of Education, Science and Technology*. 3(1). 238-244
- O'reilly (2005). *Ethnographic method*. Routledge
- Pokhrel, S. (2022). *An exploratory multiple-case study of Nepal's science teacher educators' knowledge and practices of active learning and culturally responsive teaching*. [Doctoral dissertation Clemson University]. Tiger prints. https://tigerprints.clemson.edu/all_dissertations/3049.
- Saldana, J. (2011). *Fundamentals of qualitative research*. Oxford University Press
- Taylor, P. C. (2014). Constructivism. *Encyclopedia of Science Education*, 1-8. . http://doi.org/10.1007/978-94-007-6165_102-2
- Ural, E. (2016). The effect of guided-inquiry laboratory experiments on science education students' chemistry laboratory attitudes, anxiety and achievement. *Journal of Education and Training Studies*, 4(4), 217-227. <https://doi.org/10.11114/jets.v4i4.1395>