
Exploring Experiences of Science Education Teachers on Professional Development

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Abstract

Maintaining current pedagogical strategies and remaining cutting-edge with regular updates is crucial in the field of science education, where professional development is a foundation for developing effective teaching and learning. In an effort to pinpoint issues and provide solutions, this study explores the condition of professional development among science education teachers at the Faculty of Education, Tribhuvan University (TU-FOE), Nepal. The study uses a qualitative research design that includes in-depth interviews and document analysis to provide knowledge of the professional development genre. The study's findings shed light on the complications faced by science education teachers, such as a lack of resources and support, institutional policies, technological barriers, professional burnout and a lack of opportunities for collaboration. These challenges highlight the potential link between the need for creative, specialized professional development opportunities that meet the changing demands of the sector and the requirements for science education. Therefore, the TU-FOE authority minimizing these issues and launching the professional development programme for enhancing the quality of science education teachers to improve the quality of teaching and learning in the Faculty of Education, Tribhuvan University.

Keywords: institutional policies, resource constraints, professional development, science education, Tribhuvan University

Context

In order to thoroughly examine the level of professional growth among science education teachers at Tribhuvan University, the research uses a qualitative research method that includes in-depth interviews and document analysis. As a prominent university in Nepal, Tribhuvan University is the center of this research because of its impact on professional development, especially in science education. It provides assumptions provides insight into the difficulties faced by science education teachers, such as lack of resources, professional burnout, and technological barriers. By examining important topics pertaining to science teachers' professional development, the literature review places the study in context. The study emphasizes the need for continuous professional growth, the difficulties encountered in the field of science education, the vital role of resources, the necessity of technology integration, teamwork, contextualization, and the influence of policies (Clouder et al., 2022; Kilag et al., 2023). The usefulness of the study in providing context-specific insights is shown by the author's connection of more general ideas with the particular difficulties experienced by science education teachers at Tribhuvan University.

The study guarantees representation from a range of scientific disciplines, and the integration of qualitative information strives for a thorough comprehension of the professional development of science education teachers. The implications generalize from the

qualitative data and highlight the necessity of discipline-specific initiatives, ongoing training, resource augmentation, collaboration, and policy formulation (Sims & Fletcher-Wood, 2022). Should these suggestions be put into practice, they could help to minimize the gap between the evolving demands of science education and teachers' readiness (Imants & Van der Wal, 2020), which would greatly enhance the development of science education, teaching-learning and research at TU, Nepal. The study's findings are summarized in the conclusion, which also reiterates the complex issues and makes tactical suggestions. It highlights how these suggestions might improve the environment for the professional development of science education teachers at Tribhuvan University and elsewhere, adding to the international conversation on successful science education. The acknowledgment recognizes financing from the University Grants Commission, Nepal, and expresses gratitude to the university's science education teachers.

Introduction

A nation must have access to high-quality science education in order to flourish, and scientists are vital to this process. This study aims to improve the quality of scientific education in Nepal by offering evidence-based recommendations based on the professional development environment of science education teachers at Tribhuvan University. It is impossible to overstate the value of professional growth in the ever-changing field of education, particularly in the field of science education. Science educators must stay current with contemporary advances and change their pedagogical tactics on a regular basis in order to foster better teaching-learning practices. This study initiates a comprehensive inquiry into the condition of professional development among science professors associated with Tribhuvan University in Nepal. By examining the challenges these teachers face and offering strategies for improvement. First and foremost, it is imperative to attend to the demands of teachers at Tribhuvan University (T.U.) in terms of professional development, especially with regard to science teaching. The present obstacles that science instructors must overcome, like a lack of supplies and trouble obtaining lab equipment, underscore the critical need for focused assistance and professional development programs for teachers. Prioritizing T.U. academics' professional development is an opportunity to close the resource gap that currently exists and meet the needs of high-quality science teaching. By means of extensive training programs, faculty members can obtain the requisite skills and knowledge to effectively navigate these issues, augmenting their capacity to assist scientific instructors in surmounting obstacles and cultivating a more favorable learning milieu for pupils.

Professional development needs to be proactive since scientific fields are dynamic, and teachers need to stay skilled in using cutting-edge teaching practices and capable of negotiating the complexities of their subjects. Tribhuvan University, the epicenter of Nepalese education, provides a case study to elucidate the nuanced details of professional development within the framework of science education. The unique challenges faced by scientific education teachers at this particular institution serve as a good example of more widespread issues that crop up in the field of education, providing information that could in direct more extensive improvement studies. This study focuses on Tribhuvan University since it is recognized as an important Nepalese academic institution that shapes future professionals in a range of topics, including science education, and impacts teaching methodologies. Understanding the specific challenges faced by science education teachers at TU is essential to tailoring interventions to the unique context and requirements of the classroom. The introduction mentions several challenges faced by science education teachers, including a lack of resources, limited access to modern teaching techniques, and limited opportunities for collaboration (Clouder et al., 2022; Kilag et al., 2023; Sims & Fletcher-Wood, 2022). There

may be a discrepancy between science teachers ability to meet the evolving needs of science education and the issues at hand if they are not addressed.

One of the most common problems that comes up is a lack of resources. If university students do not have sufficient access to up-to-date scientific papers, adequate laboratory equipment, and contemporary instructional materials, the content of science education may not be properly delivered and may be poorly provided (El-Haggat et al., 2023). This restriction lowers the quality of learning and makes it more challenging for educators to cultivate in their students a passion for scientific inquiry and critical thinking. To meet this problem, a multi-modal approach comprising stakeholders' engagement, strategic resource allocation, and institutional support is required. It highlights another important issue, which is limited access to modern teaching and learning methods. Science education teachers need to be knowledgeable about the latest pedagogical advancements and skilled at incorporating them when they come up. The study seeks to answer the objective 'to examine science education teachers' responses to science teachers professional development programs especially those related to FOE-TU.

The importance of the interaction between professional development for teachers and resource accessibility in determining the learning objectives of science teachers is highlighted by theoretical frameworks in education (Tran & Halversen, 2021). It is clear from socio-constructivist viewpoints that teachers must constantly learn and adapt in order to provide effective instruction, especially in the dynamic field of science education (Vygotsky & Cole, 1978). But the effectiveness of professional development programs is intrinsically linked to the resources available to teachers. From the perspective of resource dependency, teachers may find it difficult to use cutting-edge pedagogical strategies and involve students in real scientific inquiry if there is a lack of supplies, inadequate laboratory equipment, or technology tools (Nilson, 2016). Additionally, ecological systems theory highlights how different factors that affect teaching and learning processes are interconnected. It also shows how resource allocation constraints can have an impact on teacher development and student achievement in science education across educational contexts (Bronfenbrenner, 1979). Thus, creating a supportive environment that supports efficient instruction and improved student learning outcomes requires addressing resource inequities and funding extensive professional development programs catered to the unique needs of scientific instructors.

Method

In order to provide a thorough picture of the condition of professional growth among science education teachers at Tribhuvan University, this study uses a qualitative research approach, which is part of the mixed methods study as a faculty research granted by the University Grants Commission. Both the population and the sample include science education teachers teaching at four campuses that run Master's degree programme. The purposive sampling method is utilized to guarantee representation from a range of scientific areas. The selection of participants is predicated on their engagement in professional development and science education initiatives. For the study, purposively selected participants for in-depth interviews were chosen based on their backgrounds, experiences, and competence in the field of science education. This included science teacher educators from the physics, chemistry, and biology areas, with differing years of experience and participation in various professional development initiatives. Reports, professional development plans, and university rules are among the pertinent areas that are methodically chosen for examination. To collect quantitative data on a range of professional development topics, such as perceived barriers, resource availability, and document analysis of ongoing programs, an interview guidelines are used for gathering data.

To encourage in-depth interviews with participants, interview guidelines were prepared and implemented. Open-ended inquiries facilitate a deeper understanding of personal experiences, obstacles encountered, and recommendations for enhancement related to TPD. To direct the analysis of documents, a methodical framework is created, with an emphasis on science teachers' professional development at Tribhuvan University. To ensure purposive sampling of research participants, clear instructions are given and attempts are made to increase response rates. Depending on the preferences of the participants, in-depth interviews have been conducted. Document analysis, particularly the policies was done by reviewing official sources and university archives were consulted to gather pertinent papers. A comprehensive analysis is carried out to collect relevant data concerning professional growth. Qualitative data analysis has been done using verbatim and thematic methods to answer research questions. Interview transcripts are subjected to thematic analysis in order to find patterns and themes utilizing classification and coding. Throughout the research process, participants' rights to anonymity, informed consent, and respect have been closely upheld. The research offers a strong framework for examining the level of professional development among science education teachers.

Findings

The qualitative research findings provide greater knowledge of the complexity of professional development and throw light on the complicated issues faced by science education teachers at Tribhuvan University. To capture the qualitative elements of the individuals' experiences and institutional frameworks, the study employed document analysis and in-depth interviews. It was found that a recurring concern in the science education teachers' interviews was the lack of resources. It was also found that inadequate materials, which included out-of-date textbooks and a dearth of laboratory supplies, frustrated the participants. A physics education teacher pointed out,

We often find ourselves working with outdated content, and the lack of modern equipment in our laboratories limits the depth of our practical sessions.

This opinion was supported by the document analysis, which showed that existing resources are not sufficient for enhancing quality education and promoting the quality of science education teachers' professional development at Tribhuvan University. Interview perspectives: teachers of science stressed how crucial it is to keep up with contemporary teaching methods in order to properly engage pupils. The interviews did, however, reveal a significant disparity in the availability of training courses emphasizing innovative teaching methods. A lecturer in biology education said,

Workshops or training sessions on innovative teaching techniques are necessary. Many of us haven't had the opportunity to canvass these methods; therefore, the restricted availability of contemporary teaching methods is a barrier for professional development and providing quality education in the science stream.

The examination of the documents covered the history of the university's professional development programs. Even though there were sporadic seminars, it was clear that there were no consistent efforts made to incorporate contemporary teaching approaches into everyday procedures. The adoption of new methods is hampered by the lack of an organized framework for ongoing training. Science education teachers' desire for interdisciplinary exchanges and collaborative initiatives was expressed by participants, who saw collaboration as an essential component of their professional development. The interviews did, however, disclose a disjointed atmosphere with little chance for group projects. One lecturer in chemistry education said,

We need additional venues for idea sharing and teamwork. The system does not currently encourage collaborative activities for interactions.

The document analysis, which examined the institutional frameworks and regulations in place, revealed a deficiency in incentives for teamwork. Although the institution recognized the value of collaboration in general, meaningful collaboration among science education teachers was affected by the lack of organized platforms and incentives for cooperative projects. The influence of institutional policies on the professional development of the participants was often mentioned. The interviews revealed conflicting opinions; some praised policies that were helpful, while others complained about the absence of a well-thought-out plan. *Clear policies on professional development are needed*, a junior faculty member (who was recently appointed) said. Upon reviewing the official documents, 'Tribhuvan University Vision: 2030 Action Steps and Implementation Plan', the study revealed the absence of a coherent policy framework that is solely focused on the development of science education teachers. Although policies generally recognized the value of professional development, the lack of a specific plan for science teachers suggested an institutional weakness that required correction.

The interviews regularly demonstrated a sense of disconnection between the chances for professional development that are offered and the changing needs of science education teaching and learning. Teachers responses indicated that need-based specialized programs are implemented in science education that are helpful to deals with the issue unique to their subject. Indicated a need for specialized programs that deal with issues unique to their subject. *Generic workshops are beneficial, but we also need subject-specific training that tackles our unique issues*, stressed a physics education lecturer. A misalignment in the planning of professional development programs was suggested by the disparity between discipline-specific demands and the generic character of offers.

It was found that the university lecturer linked the theoretical portion of lifelong learning by refreshing their knowledge and abilities through TPD if they got the chance to participate. This finding emphasizes the necessity of professional development for science teacher educators in order to fill up the gaps in teaching materials. Initiatives for professional development can provide teachers with the most recent pedagogical techniques, technological integration know-how, and flexibility to adjust to changing curriculum materials. It shows that learning is a contextualized, active process that is impacted by the learner's history and experiences. It also shows the reflective practice approach that encourages science education teachers to critically analyze and reevaluate their instructional strategies. In this situation, science teacher educators at TU-FOE considered how their teaching efficacy is impacted by out-of-date pedagogical approaches and inadequate laboratory supplies, which may lead them to look for professional development options that address these issues.

Moreover, the principle of communities of practice can be implemented, highlighting the significance of cooperative learning among university teachers. Creating communities of practice where university teachers share ideas, resources, and creative approaches can be an essential part of professional growth, especially when it comes to addressing resource-related obstacles. The overall finding of this teacher's voice indicates a dedication to investigating the relationship between the implementation of teacher professional development activities and the difficulties presented by out-of-date pedagogical approaches and inadequate laboratory facilities. Science education teachers can become more effective in the impulsive and changing field of teaching and learning by tackling these issues through collaborative efforts, reflective practices, and ongoing learning.

Discussion

The Faculty of Education at Tribhuvan University prioritizes professional development since it shapes teachers' efficacy and competency from its establishment. The study explores the qualitative research findings that shed light on the complex difficulties faced by Tribhuvan University science education teachers. Lack of resources was a common complaint among science education teachers, particularly physics teachers. They complain about the usage of antiquated texts and the lack of contemporary laboratory equipment. This problem, which is corroborated by document analysis, highlights how inadequate the resources now available are for advancing high-quality learning and advancing the professional growth of teachers at TU-FOE.

The findings emphasized how important it is for science teachers to be up-to-date with modern teaching techniques in order to successfully engage BEd and MEd level students. There is a sizable shortfall in the supply of training programs that prioritize cutting-edge instructional strategies. A biology education lecturer emphasized the value of workshops and training sessions while highlighting the obstacle caused by the scarcity of contemporary teaching techniques. This result is consistent with previous research that emphasizes how crucial it is for teachers to have ongoing training in order to adjust to changing pedagogical techniques (Dhungana, 2022; Kadel, 2021; Panthee et al., 2023). An analysis of Tribhuvan University's professional development program history revealed periodic seminars but little persistent work to incorporate modern teaching methods. This indicates that the lack of a structured framework for continuing education is impeding the uptake of novel techniques. Research indicates that long-term success requires a systematic strategy for professional growth that emphasizes consistent efforts (Sachidanandan et al., 2022; Van Driel et al., 2001; Wuni & Shen, 2020).

The urge for collaborative projects and multidisciplinary exchanges became clear among science education teachers at TU-FOE. Professional growth was seen to depend on collaboration, yet the interviews showed a fragmented environment with few chances for group initiatives. Effective collaboration is hampered by institutional obstacles, as seen by document analysis, which highlights the lack of structured platforms and incentives for cooperative efforts. The idea that cooperative studies can increase professional development and lead to better teaching practices is supported by the literature (Acharya, 2017; Almazova et al., 2022; Evans et al., 2020; Mercader & GairínSancar, 2021). It was shown that institutional policies had a big impact on how science educators developed professionally. Divergent views emerged, with some applauding beneficial policies and others condemning the lack of a well-thought-out plan. The study's conclusions are consistent with previous research, highlighting the necessity of precise and well-thought-out strategies to direct efforts toward professional growth (Hofer et al., 2021; Imants & Van der Wal, 2020; Smith & Gillespie, 2023).

The study findings revealed a persistent gap between the professional development possibilities offered and the changing requirements of science education teaching and learning. The significance of matching professional development programs to the particular difficulties faced by science teachers is highlighted by this disparity. A physics education teacher has highlighted the need for subject-specific training programs, which is in keeping with literature that highlights the necessity for specialized professional development to address discipline-specific difficulties (Acharya, 2019; Krasnova & Shurygin, 2020; Oghly, 2023). The examination of previous professional development initiatives revealed a mismatch between the requirements of various fields and the general character of the programs that were provided. This implies that professional development initiative planning needs to be

more focused and methodically sound. Previous research supports tailored curricula that address the unique requirements of teachers in order to guarantee the applicability and efficacy of professional development initiatives (Acharya, 2019; Lowell & McNeill, 2023).

The finding offers a thorough comprehension of the obstacles encountered by science education teachers at Tribhuvan University throughout their pursuit of professional growth. The challenges that have been identified include inadequate resources, inadequate training opportunities, a dearth of platforms for collaboration, and ambiguous institutional regulations. By relating these results to previously published research, it becomes clear how urgent it is to address these issues in order to create an atmosphere that supports science educators' ongoing professional development. A proactive and customized approach to professional development is necessary to guarantee the provision of high-quality science instruction as the educational landscape changes.

It is clear from a summary of the qualitative data that Tribhuvan University's science education teachers confront a variety of difficulties as they pursue their professional development. A complicated landscape is created by a combination of factors such as a lack of resources, restricted access to contemporary teaching methods, limited chances for collaboration, and a mismatch between requirements and options. Taking on these issues requires a thorough and well-thought-out strategy. Reexamining the policy, how resources are allocated, creating a long-term professional development framework, encouraging cooperation, creating subject-specific training, and creating explicit regulations for the growth of science education teachers. The qualitative information gleaned from in-depth interviews and document analysis offers a comprehensive picture of the perspectives and experiences of science education teachers. It sets the stage for centralized interventions meant to improve the environment of science education teachers' professional development at Tribhuvan University.

In order to address this issue, FOE-TU is recommended to set aside funds specifically for ongoing resource development, guaranteeing that students have access to the most recent research findings, laboratory apparatus, and contemporary teaching resources. It is recommended that the FOE-TU take the initiative to create collaborative spaces by offering incentives for teamwork and cross-disciplinary interactions. It is advised to establish explicit policies that are only focused on the development of science teachers in order to offer a logical plan for professional development. The study's complexity extends beyond academic settings; it provides information that may be used in more general educational settings and advances the continuing discussion on efficient professional development for science education teachers.

Conclusion

The study highlights significant challenges faced by science education teachers at Tribhuvan University, including resource limitations, institutional policies, and technological barriers. Addressing these issues is crucial for enhancing the quality of teaching and learning. Implementing specialized professional development programs tailored to meet the evolving demands of the field can play a vital role in improving education standards. Thus, launching such initiatives is recommended to foster a supportive environment for science educators and ultimately elevate the quality of education at Tribhuvan University's Faculty of Education. Based on the findings, it is recommended that Tribhuvan University's Faculty of Education prioritize addressing resource limitations, revising institutional policies, and overcoming technological barriers to support science education teachers effectively. Additionally, the implementation of tailored professional development programs that cater to the specific needs of educators in the field of science education is essential for improving teaching quality.

Launching these initiatives will cultivate a supportive environment conducive to enhancing education standards within the Faculty of Education at Tribhuvan University.

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