Exploring Professional Development for Science Teachers in Educational Technology at FOE-TU

https://doi.org/10.3126/tej.v12i1.64918

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Article History

Received	Revised	Accepted
8th December, 2023	26th December, 2023	2nd Janauary, 2024

Abstract

This paper aims to provide an overview of opportunities of science education teachers' professional development in Faculty of Education, Tribhuvan University (FOE-TU). In addition, it explores the the existing situation of science education teachers professional development, existing situation and readiness of teachers to teach at B.Ed. and M.Ed. levels in science education programmes. The study uses a mixed method (QUAN-qual) i.e., sequential explanatory research design. Survey questionnaire and in-depth interviews were taken to collect quantitative and qualitative data respectively. Census sampling is used for quantitative aspect and purposive sampling is used for the qualitative part of this study. SPSS version 20 was used to analyze the quantitative data whereas thematic and verbatim approach was used to analyze the qualitative data. It is found that only about one-third (26%) of teachers taken SPSS training and only one-sixth (13%) of them taken the training of Atlas-ti software to analyze the data. Similarly, science education teachers took training for endnote (41.6%), Microsoft Teams (94.44%), and Zoom (86.11%). Faculty of Eeducation does not conduct TPD training on time and when required. It is recommended that FOE-TU should provide training for science education teachers to run effective classes at M.Ed. and B.Ed. Levels in science education programmes in Nepal. It implies that in order to ensure effective TPD in science education programs, FOE-TU must prioritize and improve professional development opportunities for science education teachers.

Keywords: Science education, Teachers, professional development, Tribhuvan University

Introduction

Established in 1959, Tribhuvan University is the largest higher education educational institution in Nepal, with its jurisdiction expanding throughout the nation. Following arriving succeeding the TU Act's implementation, all Nepalese universities were affiliated with Patna University of India since Trichandra College was founded at Ghantaghar in the year 1918. At the beginning, TU was established as a teaching

university for the administration of and the advancement of secondary education (Acharya et al., 2022). As per TU's legislative mandate, any other institution is not permitted to open the campuses (Koirala, 2022; Shrestha, 2019). With time, TU gradually lost its ability to withstand the intense pressure of the growing demand for higher education (Dhungana, 2022). As a result, TU once more switched to an annual examination system, and the private sector was permitted to open campuses either with TU's affiliation.

The majority of the resources allocated by the TU system are focused on classroom instruction within its campuses and linked institutions (Khanal et al., 2023); research is left up to the discretion of its highly qualified faculty members. Later, the university came to comprehend the worth of research, teaching, and consulting. As a result, it began to consider enhancing its own research capacity in order to expand its knowledge base in a variety of academic subjects. At TU, research is progressively being given the attention and space it deserves and is integrated into the teaching and learning process.

Since then, TU started to provide teachers training to upgrade the professional quality of teachers under FOE, TU. Professionally trained teachers under FOE-TU had a significant impact on a nation's overall socioeconomic growth and helped the country move toward a global knowledge society in order to compete with more developed economies and technologies (Dhungana, 2022). Nearly all universities worldwide have made quality assurance in higher education one of their main concerns over the past three decades as a result of the system's globalization, which has forced them to reevaluate their current practices (Seyfried & Pohlenz, 2020). In order to be abreast with global university expectations, institutions should raise their educational standards (Muhammad & Nugraheni, 2022). This can be attributed, in part, to the fact that excellent university education has the potential to advance national advancement (Xie et al., 2022). These developments include the expansion of the economy, the creation of human resource, and the globalization of university education (Tight, 2021).

Higher education is becoming more globally competitive among colleges across the globe in this technological age of globalization. University education nowadays is therefore regarded as global education (Sanusi et al., 2022). Because of this growing worldwide trend, stakeholders including governments, administrators, and academics are becoming more conscious of the need of excellence declaration in the university learning to enhance their standing among other universities. The world university ranking systems are contributing to the world tendency of excellence declaration in university education and are changing the universities' landscape (Small et al., 2022). In addition to broadening their knowledge and developing their teaching techniques, teachers engage in a wide range of activities and interactions that support their professional, social, and emotional development. These experiences can include regular, unstructured hallway talks about teaching strategies.

Three constructs related to teachers' professional development (TPD) like teaching self-efficacy, pedagogical discontentment, and teacher views about scientific teaching

and learning. These areas are emerged as fundamentally relevant to study from the large range of aspects of teacher thinking examined in previous research.

A teacher's perception of their broad scientific teaching abilities is referred to as their teaching self-efficacy. People's assessments of their operational skills to plan and carry out the actions necessary to achieve specific performance goals are known as perceived self-efficacy (Upadhyaya, 2019). The research conducted by Garet et al., (2001); Kennedy (2016); Waitoller & Artiles (2013); Parkhouse et al., (2019), and additional researchers (Fathi et al., 2021; Li et al., 2022; Polatcan et al., 2023) have shown that, in the context of reform, a teacher's feeling of self-efficacy plays a significant mediating role for change, with a moderate sense of self-efficacy being necessary for a teacher to take or adopt new instructional practices. Studies like this one and others show how crucial self-efficacy is for inquiry-based learning, particularly for instructors' capacity to use inquiry to teach (Polatcan et al., 2023; Bas, 2022).

Teachers' happiness with their previous and present teaching practices is measured by a concept called pedagogical discontentment, which is thought to be a sign of whether a person is ready for change (Melnyk et al., 2019; Fauth et al., 2019). Pedagogical discontentment represents the discord needed for students that is, teachers to look for other models or explanations for the relevant occurrences (i.e., science education). For professional development to have an impact on teachers' practices, pedagogical dissatisfaction must be weighed against each teacher's sense of self-efficacy because participation in a practice requires a certain amount of efficacy on the side of the teacher. The combination that provides the optimum affective background to facilitate practice change is strong teaching self-efficacy with heightened discontentment (Polatcan et al., 2023).

In order to improve the quality of higher education and the university's reputation in global university rankings, it intends to map the current state of excellence achievement activities in Tribhuvan University and its related colleges such as faculties, institutions, and the central departments like Central Department of Education. It does this by outlining policies and their effects in relation to TPD. The study emphasized the opportunities that quality assurance techniques have provided for the future as well as the obstacles that TU face in maintaining the quality of their TPD curricula. In order to enhance the university's culture of sustainable quality assurance and keep it above the global university rankings, the article concludes with recommendations for future quality in TPD programmes and TU-FOE policies.

Methodology

This research is carried out by applying a mixed method (QUAN-qual) i.e., sequential explanatory research design method to explore the issues related to science education TPD under FOE-TU. Only the primary data have been used for the study. But for the review of the documents, as for example, the study uses policy analysis and brief of the papers recovered as well. Four campuses under FOE-TU are selected as the sample of the study that run M.Ed. science education campuses. A census sample survey (N=36) has been taken to collect the quantitative data and to collect the qualitative data,

four in-depth interviews have been taken. Each interview was about forty minutes long. For the interview, the key informants included the Subject Committee Chairperson, experienced teachers including male and female teachers have been taken for gender balance as well as get insights from both the gender.

Since FOE-TU is actively participated in the development and implementation of a TPD system, four campuses were chosen as the study area. To gather pertinent information on the problems, four in-depth interviews with four faculty members (Subject committee chairperson, senior lady teacher, and a contract teacher as well as a senior permanent teacher) were conducted. The primary purpose of the field visits was to observe the locations and gather data regarding their current status. Thus, prior to their inclusion in this work, both quantitative and qualitative data were extracted, examined, and analyzed. They were mostly employed in analyses that addressed problems with quality control in the university education particularly in FOE-TU, Nepal.

Over the course of two months, the material was gathered from the key informants and studied from primary and secondary sources. The policy papers, reports, and other publications of the Nepalese government, as well as published articles both domestically and internationally, provided the documents used in this study. Then the related issues were used as the reference. So far as possible, gray literature were avoided.

Result

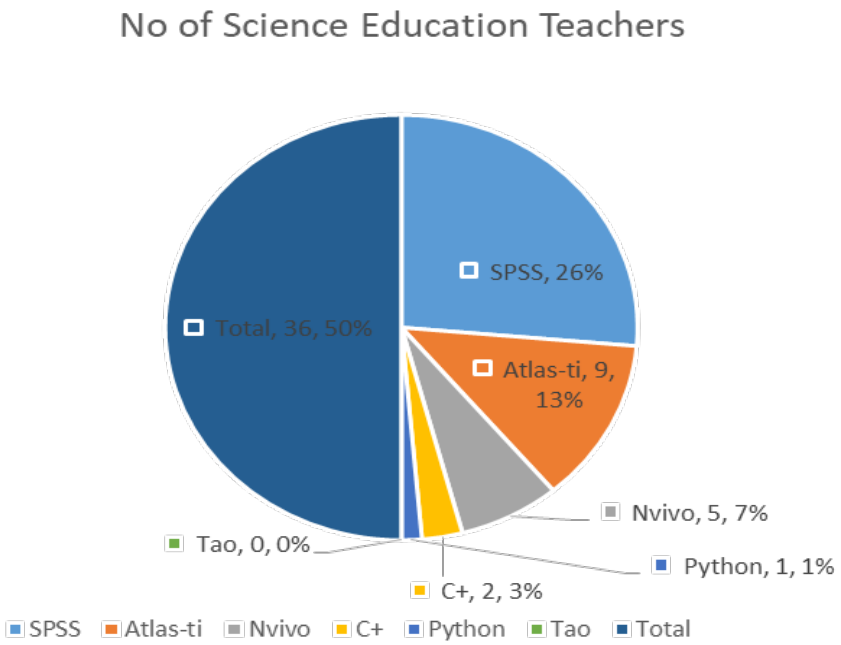
This is a portion of the research undertaken as a Faculty research under the University Grants Commission, Nepal. The result particularly related to the science education teachers' professional development training related to software, research methodology, article, proposal, academic writing, LMS and virtual teaching like Microsoft TEAMS, Zoom/Moodle, LMS, Big blue button, etc. The result shows that the distribution of software training among a group of science education teachers, with the focus on six different software tools: SPSS, Atlas-ti, Nvivo, C+, Python, and Tao. The total number of teachers involved in the training is 36. Also, SPSS emerges as the most widely adopted software among the teachers, with 19 individuals having received training in its usage. This could signify a recognition within the science education community of the value and relevance of statistical analysis, which is a key feature of SPSS (Table 1).

Table 1. ***Software Training by Science Education Teachers***

Software Training	No of Science Education Teachers
SPSS	19
Atlas-ti	9
Nvivo	5
C+	2
Python	1
Tao	0
Total	**36**

Atlas-ti is the second most utilized software, with 9 teachers having undergone training. This suggests a significant interest or need for qualitative data analysis tools, as Atlas-ti is specifically designed for handling qualitative research data. Nvivo and C+ training have been imparted to 5 and 2 teachers, respectively. The relatively lower numbers indicate a moderate adoption of these tools within the science education community. Nvivo is another qualitative data analysis software, while C+ is a programming language, possibly indicating an interest or specialized application among the educators (Fig. 1).

Figure 1. ***Pie chart showing the Percentage of Science Education Teachers use Software***



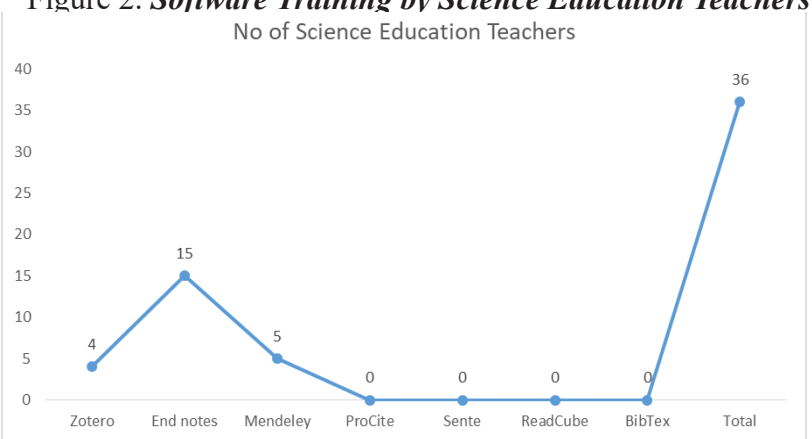
Python, a versatile and widely-used programming language, has been adopted by only 1 teacher. This is surprising given Python's prevalence in various scientific and educational fields. It could suggest a potential gap in awareness or training resources for this powerful tool. Notably, Tao shows zero training instances, indicating that none of the Science Education Teachers have received training in this particular software. This might be due to a lack of relevance, availability, or awareness about Tao within the context of science education. The data reveals a varied landscape of software training among Science Education Teachers. While SPSS and Atlas-ti have garnered substantial attention, there are opportunities for increased awareness and utilization of other tools like Python, Nvivo, and C+. Additionally, the absence of training in Tao prompts

further investigation into the reasons behind its lack of adoption within this specific educational community.

Further, science education TPD was explored on the software research methodology training like Zotero, End notes, Mendeley, ProCite, Sente, ReadCube and BibTex. The result shows that the provided quantitative data outlines the extent of research methodology training among Science Education Teachers, focusing on six distinct software tools: Zotero, EndNote, Mendeley, ProCite, Sente, and ReadCube, with a mention of BibTex. The total number of teachers included in this analysis is 24. EndNote emerges as the most widely adopted software among the teachers, with 15 individuals having received training. This dominance in numbers suggests a strong inclination towards EndNote, potentially due to its established reputation and extensive features in managing bibliographic references. The relatively high number may also signify the importance placed on research methodology within the science education domain. Zotero and Mendeley follow closely behind, with 4 and 5 teachers trained, respectively. While their numbers are lower than EndNote, these findings suggest a diverse interest in reference management tools. Zotero, known for its open-source nature, and Mendeley, with its collaborative features, appeal to educators with different preferences and requirements (Table 2).

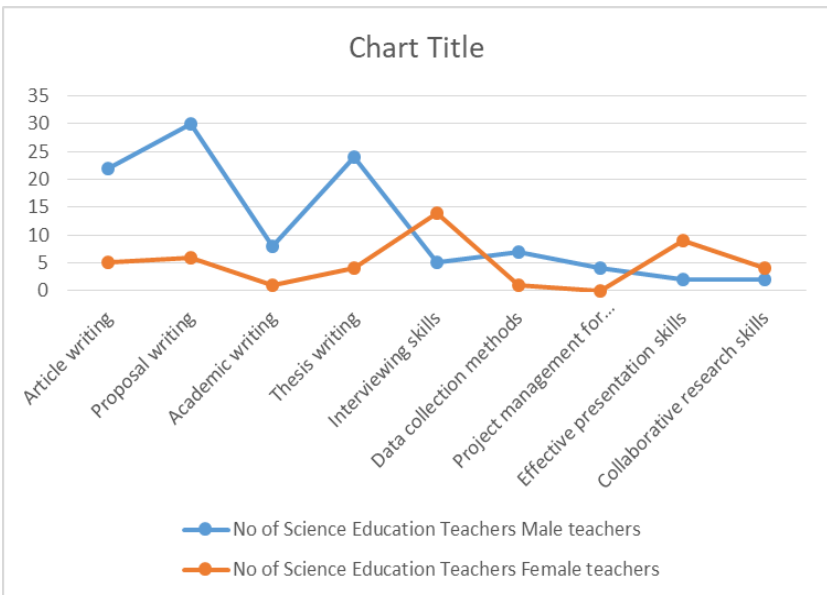
However, the absence of training in ProCite, Sente, ReadCube, and BibTex is insignificant. This could indicate a lack of awareness, relevance, or perhaps the perceived complexity of these tools within the science education community. The zero values for these software options suggest potential areas for improvement in terms of introducing educators to a broader spectrum of research methodology tools. BibTex, although mentioned, also shows zero training instances. This could be due to its more specialized use, often employed in conjunction with LaTeX for bibliography management, and may not be as pertinent to the needs of the majority of Science Education Teachers. The data paints a picture of a predominant reliance on EndNote within the Science Education Teachers community for Research Methodology training.

Figure 2. ***Software Training by Science Education Teachers***



The result explored the condition of general research methodology training particularly related to article writing, proposal writing, academic writing, thesis writing, etc. The result shows the comparison between male and female science education teachers under FOE-TU. They provided a detailed breakdown of general research methodology training for Science Education Teachers, categorized by gender. The data encompasses various aspects of research methodology, including article writing, proposal writing, academic writing, thesis writing, interviewing skills, data collection methods, project management for research, effective presentation skills, and collaborative research skills. Article writing appears to be a common focus for both male and female teachers, with 22 male teachers and 5 female teachers having received training in this area. This may indicate a shared emphasis on developing skills related to scholarly publications within the science education community. Proposal writing is another prominent area of training, with 30 male teachers and 6 female teachers having undergone training. The higher numbers here suggest a collective recognition of the importance of crafting research proposals, possibly reflecting the competitive nature of securing research funding within the field.

Figure 3. Comparison between Male and Female Teachers on Research Methodology Training



The data highlights a diversity of training areas within general research methodology for Science Education Teachers, with varying levels of emphasis based on gender. While certain topics like proposal and thesis writing appear to be universally prioritized, there are nuanced differences in the distribution of training across specific skills, presenting opportunities for more tailored professional development initiatives.

The analysis of science education teachers professional development shows that the use of Learning Management Systems (LMS) and Virtual Teaching Learning

platforms among Science Education Teachers. The data is segmented based on the number of teachers who received training in each platform. Microsoft TEAMS emerges as the most widely adopted platform, with 34 teachers having undergone training. This dominance may be attributed to the widespread use of Microsoft tools in educational settings, coupled with the comprehensive features offered by Microsoft TEAMS for virtual collaboration and communication. Zoom platform closely follows, with training received by 31 teachers. The popularity of Zoom in facilitating virtual meetings and classrooms is evident, showcasing its prevalence as a preferred platform for Science Education Teachers engaged in remote or online teaching (Table 3).

Table 3. Virtual Learning Methods

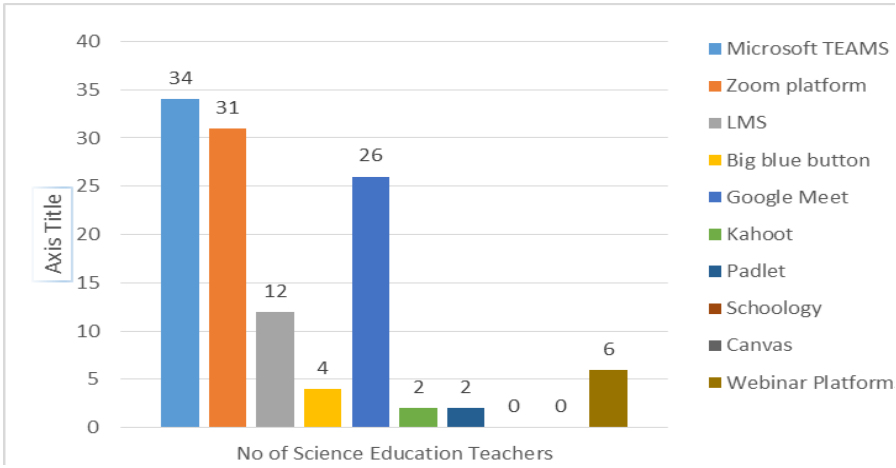
LMS/ Virtual Teaching Learning Training	No of Science Education Teachers
Microsoft TEAMS	34
Zoom platform	31
LMS	12
Big blue button	4
Google Meet	26
Kahoot	2
Padlet	2
Schoology	0
Canvas	0
Webinar Platforms	6

Google Meet is also prominently represented, with 26 teachers having received training. Google Meet's integration with other Google Workspace tools and its ease of use likely contribute to its popularity among educators, facilitating seamless virtual interactions. LMS, or Learning Management System, has been adopted by 12 teachers. This suggests that a subset of educators has engaged with broader platforms designed to manage and organize educational content, assignments, and communication in a virtual environment. Big Blue Button, Kahoot, and Padlet exhibit lower training numbers, with 4, 2, and 2 teachers respectively. While these platforms may cater to specific needs such as interactive learning (Kahoot) or collaborative content creation (Padlet), the lower figures indicate a more niche usage among the surveyed Science Education Teachers. Schoology and Canvas show no instances of training, suggesting that these specific Learning Management Systems may not be as widely utilized or considered in the training programs for Science Education Teachers. The reasons behind this absence could range from platform accessibility to a perceived lack of relevance or awareness among educators.

Webinar Platforms have been adopted by 6 teachers, emphasizing the importance placed on virtual events, seminars, and training sessions within the professional

development landscape.

Figure 4. ***Bar diagram showing the Teachers taking Software through TPD***



In conclusion, the data underscores the varied landscape of LMS and virtual teaching platform adoption among Science Education Teachers. While Microsoft TEAMS, Zoom, and Google Meet dominate, the lower numbers for certain platforms indicate the need for a tailored approach in training programs, ensuring educators are equipped with the most relevant tools for effective virtual teaching and learning experiences.

The qualitative part of the study found that looking into the possibilities for professional growth that Tribhuvan University (TU) science education instructors have access to. The findings of this study show that TU's Faculty of Education (FOE) professional development programs did not meet the needs of scientific education teachers. Teachers who participated in interviews pointed out that there aren't enough chances for professional development and training programs in the field of scientific instruction. They specifically pointed out a lack of regular and thorough training sessions, which are necessary to stay up to date with the newest advancements and approaches in scientific instruction.

Additionally, the study shows that there is a sizable disparity in science educators' learning of research-based competencies. Teachers at Tribhuvan University noted a lack of research-oriented abilities, despite the fact that these are essential for efficiently delivering science education. They underlined the need for training programs that concentrate on giving them the necessary research abilities to improve their methods of instruction and further scientific education. This disparity emphasizes how badly Tribhuvan University's professional development programs for science education teachers need to be improved and reformed, with a focus on giving them access to more thorough and modern training opportunities that are specifically designed to meet their needs.

Discussion

The results of this study provide valuable insights into the intersection of TPD in relation with the general training, software training and virtual learning methods of of science education teachers in FOE-TU, Nepal. The complex web of relationships among these elements postulate a comprehensive discussion that explores their interplay and implications, all while considering the extensive body of empirical reviews and theoretical foundations. These findings resonate with existing literature, as Acharya et al., (2022) highlighted the potential of TPD to transform traditional pedagogical approaches by introducing active, experiential learning methods. This reiteration underscores the transformative role of TPD training as contextual scaffolds for university science education, particularly in regions where conventional theoretical instruction is predominant (McLean & Attardi, 2023). This reinforces the notion that TPD trainings are not only viable teaching tools but also capable of shifting pedagogical paradigms (Shishigu, 2022), ultimately contributing to enhanced thoughtful meaning of the lessons. Collaboration and team work are the prominent educational philosophy, plays a significant role in elucidating the findings of this study. Rooted in the idea that students actively construct knowledge and understanding through their experiences (Archambault, Leary, & Rice, 2022), collaboration and team work aligns seamlessly with the notion of experiential learning within the university classes (Moon et al., 2023).

The teachers' active involvement in nurturing, and sharing not only fosters deeper comprehension of scientific principles and software knowledge but also exemplifies the TPD principle that learning is most effective when it is situated within authentic contexts. Acharya and the team research echoes these notions by focusing on the significance of TPD in higher education in Nepal (Acharya et al., 2022). The empirical evidence from various researchers, including Acharya et al., (2022) and those conducted by Polatcan et al., (2023), reinforces the significance of team work in the context of the effective implementation of TPD in the university level. Previous studies suggest that the tangible experiences offered by TPD training enable university teachers and faculties to construct their knowledge actively. Teachers, in these settings, not only acquire pedagogical skills but also construct their awareness of the classes and the practical implications for transformative genure. Addressing 'local needs' would help teachers to develop quality (Gurung & Parajuli, 2021). This alignment between the empirical reviews and the team work philosophy accentuates the role of TPD as transformative environment in the university where teachers take an active role in shaping their learning experiences. In parallel, it is pivotal to recognize the alignment between sharing and the collaboration introduced within university science education.

While sharing culture underlines the significance of practical problem-solving and experiential learning, it also values adaptability and resourcefulness, both of which are intrinsic to TPD (Parkhouse et al., 2019). To recover from the 'negative view of learning', we need to implement effective TPD programmes (Timilsena et al., 2022). Proper implementation of approved education policies is essential to achieve the desired goal of education (Paudel & Rajbhandary, 2022). The engagement of teachers

in PTD activities within the university signifies a dynamic fusion of collaboration and sharing and thinking culture. University teachers are not just acquiring software skills; they are developing a general pedagogical skills that emphasizes adaptability and resourcefulness, aligning with TPD philosophy.

The distribution of software training among scientific education instructors is shown by the results in the table, which also shows how many teachers have received training in different software packages. The statistical package for the social sciences, or SPSS, is the most often used program among the teachers polled, according to the statistics, with 19 of them having undergone training in its use. After SPSS, qualitative data analysis programs like Atlas.ti and Nvivo are also fairly common among scientific education instructors, with 9 and 5 teachers trained in each program. Interestingly, though, only a relatively lower percentage of teachers have training in programming languages like Python (1 teacher) and C+ (2 teachers). Furthermore, the data suggests that there may be a software education gap in the cohort because none of the teachers that were surveyed had any Tao training. These results point to a varied landscape of software use among science education teachers, with differing exposure to and levels of competency with various technologies (Paudel & Rajbhandary, 2022).Empirical research conducted by Small (2022), with its connection to collaboration and the adaptability necessitated underscores the TPD aspects found in the university.

The multifaceted strategies implemented by different types of TPD packages highlight the training approach of adapting to changing circumstances through flexible and resourceful methods, further emphasizing the relevance of skill-oriented education within the university class context. This empirical evidence mirrors the perspective presented by Acharya et al., (2022), which identified initial barriers and later positive experiences in TPD in higher education in among science education teachers. Teachers' professional development is a must in the schools in Nepal (Acharya, 2019; Acharya et al., 2022). The discussion has expanded to encompass the intricate relationships between TPD, collaboration, team work and transformative mind-set, demonstrated by Acharya and his friends' work. This integrative perspective contributes to the ongoing discourse on transformative university education and the pivotal role of practical experiences in nurturing adaptable and conscientious lifelong education.

It is essential to acknowledge the implications of demographic factors on university teachers TPD skills, as illuminated by this research. This alignment with Acharya and his friends (2022) findings reveals that more male teachers took software training in comparison to the female teachers in the university. This study offers a significant contribution to the existing body of knowledge regarding the role of TPD in fostering science learning and science education teachers' skills. By emphasizing the transformative potential of TPD in introducing practical experiences into the educational curriculum, this research underscores their multifaceted impact on teachers' learning outcomes. The practical implications extend to the realm of teacher training, curriculum development, and higher educational policy in Nepal. The findings not only emphasize the significance of practical experiences but also underscore the

complexities surrounding demographic disparities in learning outcomes. Therefore, this research underscores the intricate and comprehensive nature of TPD programme as powerful catalysts for holistic education and calls for continued research to unlock their full potential in diverse educational contexts. Further exploration of the long-term effects of TPD and the broader sustainability and scalability of such initiatives is warranted to maximize their impact and integration into the educational landscape.

This study encourages further research to advance the transformative potential of TPD training, highlighting the need for customized, inclusive, and innovative educational approaches to empower university science education teachers with a multifaceted skill set for the future. Examining obstacles faced by science education teachers in Tribhuvan University regarding their professional development. Utilizing a combination of quantitative (QUAN) and qualitative (qual) research methodologies to comprehensively analyze the complexities of science education teacher training. Investigating the adoption and training levels of various Learning Management Systems and virtual teaching tools, including Microsoft Teams, Zoom, SPSS, Atlas-ti, Padlet, and Kahoot. Highlighting differences in training opportunities between male and female science education teachers within the context of Tribhuvan University. Proposing actionable suggestions for Tribhuvan University to enhance the quality of science education by providing targeted training programs for teachers at both M.Ed. and B.Ed. levels.

Conclusion

We put up research claims in an attempt to address the general question of what is the situation of to quantify professional development and its impact on teaching and student accomplishment. We contend that as a field, we have empirically come to an agreement on a number of fundamental elements and a conceptual framework for teacher learning, and that going forward, we should apply the framework in research on the efficacy of professional development while allowing for individual customization. These areas of agreement would allow for cross-study comparisons and act as a guide for what metrics are necessary to expand our body of knowledge.

Reforms in teaching and learning depend on professional development, thus it's critical that we measure its results using best practices. In order to improve professional development studies and, in turn, our knowledge of how to design and carry out teacher learning opportunities for the greatest possible benefit to both teachers and students, I propose that we make greater use of this study.

Acknowledgments

I extend our gratitude to science education teachers under FOE-TU who contributed in this study. My gratitude goes out to the University Grants Commission, Nepal, for awarding the Faculty Research Grants (award no. FRG-79/80-Edu-01).

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