Existing Situation of Digital Pedagogy in the Mathematics Classroom

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Abstract: *This article examines the existing situation of digital pedagogy in mathematics classrooms at Tribhuvan University, focusing on the skills and activities of mathematics teachers. Digital pedagogy, the integration of ICT tools and techniques in teaching, can potentially enhance teaching and learning activities. However, there are challenges in implementing digital pedagogy, such as limited access to technology and inadequate teacher preparation programs. This study utilized a cross-sectional research design with quantitative methodology. Data were collected from mathematics teachers of constituent campuses at Tribhuvan University using self-constructed closed-structure questionnaires. The results indicated that mathematics teachers possess varying levels of digital skills, with proficiency in producing documents and using emails but lower proficiency in developing questions and mathematical documents using Latex. The teachers frequently use the Internet to collect information and employ digital presentation tools. However, the usage of online resources and platforms for learning materials and homework posting was occasional. The findings underscore the importance of targeted training and resource provision to enhance digital skills among mathematics teachers. Tribhuvan University should prioritize technology access, improve teacher preparation programs, and promote digital literacy. By addressing these challenges, Tribhuvan University can effectively integrate digital pedagogy in mathematics classrooms, leading to enhanced teaching and learning experiences and improved student outcomes.*
Keywords: *Digital pedagogy, mathematics classrooms, skills, cross-sectional study, Tribhuvan University*

Introduction

Digital pedagogy in mathematics classes, or applying ICT tools, techniques, and methodologies in both virtual and physical classes, would improve teaching-learning activities (Dahal et al., 2010; Das & Bag, 2020; Naik et al., 2021). This pedagogy, or the use of technology in education, has completely changed how people teach and learn worldwide. Recent years have seen a rise in interest in using digital pedagogy in mathematics courses at Tribhuvan University, one of Nepal's oldest and most esteemed institutions of higher learning. For students to be ready to thrive in the digital age, digital tools and resources must be incorporated into the mathematics curriculum as technology continues to overgrow. The use of interactive simulations, virtual manipulative, online tests, collaborative learning environments, and access to various educational resources are just a few of the many benefits digital pedagogy offers in mathematics education (Broadband Commission UNESCO, 2020; Churchill, 2017; Drijvers et al., 2016). These resources can improve student engagement, encourage active learning, support tailored instruction, and offer quick feedback, ultimately leading to the development of deeper conceptual comprehension and critical thinking abilities (Broadband Commission UNESCO, 2020; Jesson et al., 2018; Kihoza et al., 2016). Nevertheless, despite the potential advantages, there are several difficulties in applying digital pedagogy in Tribhuvan University's mathematics classes. These difficulties can include restricted access to technology and internet connectivity, a lack of teacher preparation programs and inadequate levels of digital literacy among educators. However, digital pedagogy will inevitably be used in mathematics classes. Nevertheless, there is a need to give teachers

in the Nepalese environment a chance to advance their knowledge and abilities for the benefit of students(Dahal & Dahal, 2015).

It is essential to comprehend the existing condition of digital pedagogy in mathematics classes at Tribhuvan University to pinpoint problem areas and create winning development plans. Tribhuvan University can improve mathematics instruction, empower teachers and students, and progress education generally in Nepal by utilizing technology. So, researcher wants to examine the existing situation of digital pedagogy in mathematics classrooms at Tribhuvan University. This exploration will shed light on the current state of affairs, highlight the existing challenges and opportunities, and propose potential strategies for further enhancement.

Methods and Materials

This study used a cross-sectional research design under quantitative methodology (Apuke, 2017; Reaves, 1992; Setia, 2016). The research's target population was those working at Tribhuvan University as mathematics educators. The researcher used random sampling to choose all mathematics teachers from seven provinces of the twenty-six constituent campuses of the Tribhuvan University Faculty of Education. A random sample method was used for this investigation to get the data(Cochran & William, 1977). I collected data using a multistage random sampling method. The data was first gathered from 78 respondents from the seven constituent campuses chosen for the study. Data were collected through self-constructed closed-structure questionnaires using Google Forms. Data were analyzed descriptively and inferentially using one sample-t test and one-way ANOVA. The one-sample t-test was employed to test the significant results of the sample mean with the assumed population mean. The statistical package for social science (SPSS) was used as a data analysis tool.

Result and Discussion

The researcher collected the data from 78 respondents teaching mathematics at Tribhuvan University, faculty of education. Existing situation of digital pedagogy in the mathematics classroom is analyzed through the data from teachers' digital technology-related skills, digital technology-based activities and materials used for teaching by teachers. The sample characteristics and existing situation of digital pedagogy in the mathematics classroom at Tribhuvan University are discussed below.

Characteristics of the Sample Variables

Among the respondents, 81.1% of mathematics teachers were male, and 18.9% were female. Similarly, 43.2% had masters, 40.5% had MPhil, and 16.2% had PhD qualifications. Regarding the teaching experiences of respondents, 8.1% had 0-5 years, 13.5% had 6-10 years, 16.2% had 11-15 years, 24.3 % had 16-20 years, and 37.9% had over 20 years of teaching experience.

Digital Skills of Teachers

The digital skills of mathematics teachers play a crucial role in effectively integrating technology into their teaching practices (Amhag et al., 2019; Hämäläinen et al., 2021; Instefjord & Munthe, 2016). It is essential for mathematics teachers to continuously develop and enhance their digital skills through

professional development programs, workshops, and self-learning(Tømte et al., 2015). By acquiring and refining these digital skills, mathematics teachers can effectively leverage technology to improve classroom teaching and learning experiences (Martin et al., 2021; Tabach & Trgalová, 2020; Tay et al., 2021). A survey was conducted to gather information, and respondents were asked to rate their proficiency in various digital skills using a Likert scale.

Table1. *Status of Digital Skills of mathematics teachers*

Statements	Frequency	Mean	SD	t-value	P-value
Produce a document using a word processing Programme.	78	3.02	0.856	2.552	0.033
Use a spreadsheet (Excel) to draw charts.	78	2.56	0.975	0.143	0.890
Create a presentation with simple animation functions	78	2.69	0.920	0.737	0.485
Use emails to communicate with others	78	3.49	0.616	7.150	0.000
Develop questions and mathematical documents on Latex	78	1.78	0.783	-3.200	0.004
Download and install Mathematical software on a computer	78	2.87	0.916	0.751	0.452
Sharing learning resources through LMS (Ms Teams. Moodle, etc.)	78	2.66	0.792	0.982	0.488
Capture and edit digital photos, movies, or other graphics	78	2.44	0.543	-0.164	0.764

Source: Field survey 2022

The following subsections present the results and discussions for each digital skill of mathematics teachers shown in table 1. Produce a document using a word processing Programme: 78 mathematics teachers participated in the survey. The mean rating for this skill was 3.02 (SD = 0.856). A t-test was performed to compare the mean rating to the neutral value of 2.5. The t-value was 2.552, and the corresponding p-value was 0.033, indicating a statistically significant difference from the neutral rating. These findings suggest that most mathematics teachers at Tribhuvan University possess sufficient skills in producing documents using word processing programs.

Use a spreadsheet (Excel) to draw charts: For this skill, the mean rating was 2.56 (SD = 0.975), with no significant deviation from the neutral rating ($t = 0.143$, $p = 0.890$). This suggests that mathematics teachers are generally proficient in using spreadsheets to draw charts.

Create a presentation with simple animation functions: The mean rating for this skill was 2.69 (SD = 0.920). Similar to the previous skill, no significant deviation from the neutral rating was observed ($t = 0.737$, $p = 0.485$). These results indicate that mathematics teachers at Tribhuvan University possess average competence in creating presentations with simple animation functions.

Use emails to communicate with others: In this skill, the mean rating was 3.49 (SD = 0.616), significantly exceeding the neutral rating ($t = 7.150$, $p = 0.000$). This indicates that mathematics teachers at Tribhuvan University are highly proficient in using emails.

Develop questions and mathematical documents on LaTeX: The mean rating for this skill was 1.78 (SD = 0.783). A significant deviation from the neutral rating was observed ($t = -3.200$, $p = 0.004$). These

findings suggest that mathematics teachers at Tribhuvan University have relatively low proficiency in developing questions and mathematical documents using LaTeX.

Download and install Mathematical software on a computer: For this skill, the mean rating was 2.87 (SD = 0.916), with no significant deviation from the neutral rating (t = 0.751, p = 0.452). This indicates that mathematics teachers at Tribhuvan University possess an average level of competence in downloading and installing mathematical software.

Sharing learning resources through LMS (Ms Teams, Moodle, etc.): The mean rating for this skill was 2.66 (SD = 0.792), with no significant deviation from the neutral rating (t = 0.982, p = 0.488). These results suggest that mathematics teachers at Tribhuvan University have average proficiency in sharing learning resources through Learning Management Systems.

Capture and edit digital photos, movies, or other graphics: The mean rating for this skill was 2.44 (SD = 0.543). No significant deviation from the neutral rating was observed (t = -0.164, p = 0.764). This indicates that mathematics teachers at Tribhuvan University possess moderate competence in capturing and editing digital media.

Overall, the results indicate that mathematics teachers at Tribhuvan University have varying levels of digital skill proficiency across different areas. Skills related to using emails for communication purposes and producing documents using word processing programs were found to be highly developed. Conversely, mathematics teachers demonstrated relatively lower proficiency in developing questions and mathematical documents using LaTeX. These findings highlight the importance of targeted training and professional development programs to enhance digital skills among mathematics teachers at Tribhuvan University.

Digital Pedagogy-Based Activities and Materials Used for Teaching

For university teachers, using digital pedagogy-based activities and materials is crucial while teaching mathematics(Ebrahim, 2002). By embracing digital pedagogy, mathematics teachers can develop a cutting-edge, welcoming learning environment that promotes a deeper comprehension and mastery of mathematical concepts(Das & Bag, 2020). Teachers' digital pedagogy-based activities and materials used for teaching are shown in table 2. The researcher used a five-point Likert scale, i.e., never, occasionally, sometimes, often, and always through five statements to measure the digital pedagogy-based activities and materials used for teaching. A t-test was performed to compare the mean rating to the neutral value of 3.(Fernandes et al., 2020; Wanjala, 2015)

Table 2. *Digital Pedagogy-Based Activities and Materials Used for Teaching*

Statements	Numbers	Mean	SD	t- Value	P-Value
Browse/search the Internet to collect information to prepare lessons	78	3.50	0.402	3.045	0.008
Browse or search the Internet to collect learning material or resources to be used by students during lessons	78	3.38	0.557	1.840	0.124
Use digital mathematical tools (GeoGebra, Mathematica, etc.) to prepare presentations for lessons	78	2.30	1.046	2.301	0.035

Download/upload/browse material from the virtual learning environment/learning platform	78	3.83	1.220	2.562	0.032
Post homework for students at the learning platform	78	3.30	0.871	0.876	0.484
Use the online digital library to search for digital resources	78	3.40	1.031	0.754	0.557

Source: Field survey 2022

Browse/search the Internet to collect information to prepare lessons: The mean rating for this statement was 3.50 (SD = 0.402). A t-test was conducted, and the t-value was 3.045, with a p-value of 0.008. These results indicate that mathematics teachers at Tribhuvan University frequently use the Internet to collect information for preparing lessons, and this usage is statistically significant.

Browse or search the Internet to collect learning material or resources to be used by students during lessons: For this statement, the mean rating was 3.38 (SD = 0.557). Although the mean rating is high, there was no significant deviation from the neutral rating (t = 1.840, p = 0.124). This suggests that mathematics teachers at Tribhuvan University occasionally use the Internet to collect learning materials or resources for students during lessons.

Use digital mathematical tools (GeoGebra, Mathematica, etc.) to prepare presentations for lessons: The mean rating for this statement was 2.30 (SD = 1.046). A t-test was conducted, and the t-value was 2.301, with a p-value of 0.035. These results indicate that mathematics teachers at Tribhuvan University use digital mathematical tools to prepare presentations for lessons, and this usage is statistically significant.

Download/upload/browse material from the virtual learning environment/learning platform:

For this statement, the mean rating was 3.83 (SD = 1.220). A t-test was conducted, and the t-value was 2.562, with a p-value of 0.032. These results indicate that mathematics teachers at Tribhuvan University frequently download, upload, and browse materials from the virtual learning environment or learning platform.

Post homework for students at the learning platform: The mean rating for this statement was 3.30 (SD = 0.871). There was no significant deviation from the neutral rating (t = 0.876, p = 0.484). This suggests that mathematics teachers at Tribhuvan University occasionally use the learning platform to post homework for students.

Use the online digital library to search for digital resources: The mean rating was 3.40 (SD = 1.031) for this statement. There was no significant deviation from the neutral rating (t = 0.754, p = 0.557). This indicates that mathematics teachers at Tribhuvan University occasionally use online digital libraries to search for digital resources.

In summary, it is based on the table2. mathematics teachers at Tribhuvan University show a significant usage of browsing/searching the Internet to collect information for lesson preparation, using digital mathematical tools for preparing presentations and downloading /uploading/ browsing materials from the virtual learning environment or learning platform. However, browsing/searching the Internet for learning materials, posting homework on the learning platform, and using online digital libraries to search for digital resources appear occasional and not statistically significant.

Finding and Discussion

This study aimed to examine the existing situation of digital pedagogy in mathematics classrooms at Tribhuvan University. The findings revealed that mathematics teachers at Tribhuvan University have varying proficiency levels and engagement with digital pedagogy-based activities and materials. Regarding digital skills, the results showed that mathematics teachers possess sufficient skills in producing documents using word processing programs. They also demonstrated high proficiency in using emails for communication purposes. However, their proficiency in developing questions and mathematical documents using Latex was relatively low(Amhag et al., 2019).

Regarding digital pedagogy-based activities and materials used for teaching, mathematics teachers at Tribhuvan University frequently browse and search the Internet to collect information for lesson preparation. They also utilize digital mathematical tools for preparing presentations and often download, upload, and browse materials from the virtual learning environment or learning platform. However, browsing and searching the Internet for learning materials, posting homework on the learning platform, and using online digital libraries for searching digital resources were occasional.

These findings highlight the importance of providing targeted training and professional development programs to enhance digital skills among mathematics teachers(Amhag et al., 2019). It is crucial to focus on improving proficiency in using digital mathematical tools, developing skills in Latex, and exploring the potential of online digital libraries for accessing digital resources(Trujillo-Torres et al., 2020). To fully realize the benefits of digital pedagogy in mathematics education, Tribhuvan University should prioritize providing adequate resources, such as technology access and internet connectivity, to support the implementation of digital pedagogy in classrooms.

Additionally, initiatives should be taken to enhance teacher preparation programs and improve digital literacy among mathematics educators (Hämäläinen et al., 2021; Jesson et al., 2018; Tabach & Trgalová, 2020). By addressing these challenges and providing the necessary support, Tribhuvan University can create an environment that fosters the effective integration of digital pedagogy in mathematics classrooms. This, in turn, will enhance teaching and learning experiences, promote student engagement, and contribute to developing deeper conceptual comprehension and critical thinking abilities among students.

Conclusion

Overall, this study provides valuable insights into the existing condition of digital pedagogy in mathematics classrooms at Tribhuvan University and emphasizes the need for continuous efforts to promote and enhance the integration of digital pedagogy in mathematics education.

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