Digital Devices Used in a Secondory School: A Case Study of Access and Use in Learning Mathematics

Prabin Maharjan
MPhil Scholar, Graduate School of Education, Tribhuvan University, Nepal
Email: masterprabin@gmail.com

Article Info:
Received: April 9, 2023 | Revised: May 8, 2023 | Accepted: October 20, 2023

Abstract: This research investigates the types of digital devices used by students at a Secondary School in Kiritpur Municipality, Nepal, and their relationship with grade level, focusing on integrating technology in teaching mathematics. The case is urban school phenomena. A survey was conducted with 420 students, using a questionnaire for data collection. Statistical tools used in analysis included univariate (frequency and percentage) and bivariate (Chi-Square) methods. Findings show that mobile devices are the most widely used for attending online classes. Around 25% of students lack access to necessary technology at least mobile too. Attendance rates vary between lower and higher grade levels. Importantly, the study reveals limited technology integration at an urban School, with teachers lacking awareness of how to effectively adapt and incorporate technologies in the classroom, specifically for mathematics teaching. These results underscore the need to improve digital device availability and the types for teaching science, mathematics like subjects, which demand dynamic, interactive tools use. Similarly, access to devices particularly at the lower secondary level is lower, and over reliance on parents' device needs reducing reliance on parental devices. Additionally, there is a call for enhanced professional development to support teachers in integrating technology into mathematics instruction. Addressing these challenges will contribute to enhancing the learning experience and overall effectiveness of technology integration in the classroom.

Key Keywords: *Pandemic Disruptions, Digital Disparities, Math-Tech Integration, Urban-Rural Divide, Tech Matrix in Education*

Introduction

The COVID-19 pandemic caused significant disruptions to global education systems, affecting over 1.6 billion learners in more than 190 countries. School closures impacted 94 percent of the world's student population, rising to 99 percent in low and lower-middle-income countries. The impact varied based on the level of development, with 86 percent of primary school children effectively out of school in low human development countries, compared to only 20 percent in countries with very high human development.

In Nepal, the lockdowns resulted in temporary closures of schools and universities for approximately two months. Lennox, Reuge, and Benavides (2021) estimated that nearly nine million students in Nepal were affected by these closures, with varying proportions across different education levels. The Ministry of Education in Nepal responded to the situation by issuing guidelines on May 31, 2020, allowing educational institutions to use alternative methods such as radio, television, personal computers/smartphones, and the internet to facilitate student learning. Most private schools in Nepal opted for online instruction, even extending it to the pre-primary or kindergarten level. These schools primarily relied on free versions of video chat platforms like Zoom and Google, while some utilized Microsoft's licensed product, Team (Khanal, 2020).

In this context, the paper attempts to find out the different types of digital devices that were used to attend the online classes during the lockdown period. Consequently, the paper explores how the integration of technology is carried out in teaching mathematics in online classes. The researcher performs a case study at a secondary school to find out whether the integration of technology in teaching mathematics is carried out by following a technology integration framework.

This case school is situated in the Kirtipur municipality. According to Maharjan (2021), the school falls into the category of being adequately equipped to facilitate online classes. The school possesses desktop PCs, laptops, printers, high-speed internet connectivity, and a power backup system. Additionally, the school has organized digital literacy and computer skills training for its staff members, and it is currently providing training sessions to familiarize both staff and students with the latest advancements in information and communication technology (ICT). However, the school has yet to provide training on the integration of ICT into classroom teaching. From the availability of the digital ecosystem in the school it seems that this school is an educational institution located in an urban setting, equipped with suitable and sufficient IT infrastructure to conduct online classes. But, the important things is the necessary access of digital device and connectivity on the part of the students for effective implementation of online learning.

Disparities in Access and Skills for ICT in Nepal's Education System

Significant disparities exist between urban and rural areas of Nepal in terms of access, motivation, and skills related to ICT infrastructure (Rana, Greenwood, & Henderson, 2022). Nevertheless, in urban areas, access to digital tools is higher due to better infrastructure and availability of resources. Urban schools have computer labs, internet connectivity, and technology-based training centers, providing students with opportunities to engage with digital tools. Moreover, urban areas benefit from the presence of technology-based training centers, libraries, and internet cafes, further enhancing access to digital tools (Devkota et al., 2021). On the contrary, rural areas face challenges such as limited infrastructure, lack of electricity, and internet connectivity issues. Many rural schools lack computer labs and trained teachers, hindering students' access to digital tools and skills development (Karki, 2019). Furthermore, urban areas exhibit higher levels of motivation and perceived relevance towards digital tools. Students in urban schools have greater access to modern devices like smartphones, tablets, and laptops, fostering familiarity and enthusiasm for digital tools. Additionally, the urban environment offers diverse opportunities for students to witness the application and impact of digital tools in various domains(Tiwari, 2021). In contrast, limited exposure to digital tools in rural areas leads to lower motivation levels. Students may lack awareness of the benefits and relevance of digital tools in education and face socio-economic factors, such as limited resources and parental support, affecting their motivation levels (Devkota et al., 2021; Maharjan, 2021; Maski Rana, 2018; Tiwari, 2021). Moreover, urban schools have an advantage in terms of access to digital skills training programs and workshops. The urban environment facilitates interaction with technology professionals, allowing students to acquire relevant digital skills (Upadhyay, Koirala, & Sedain, 2021). Conversely, rural areas face challenges such as a shortage of trained teachers, limited availability of training programs, and difficulties accessing training opportunities in remote and geographically isolated schools (Maski Rana, 2018). On the other hand, the lack of exposure and resources further contribute to the disparity in digital skills between urban and rural schools in Nepal. However, collaborations with NGOs, private organizations, and government initiatives aim to bridge this gap by providing training opportunities for teachers and students (Rana et al., 2022).

Integrating Technology to Enhance Mathematical Processes in Mathematics Education

The integration of technology in education is driven by the goal of cultivating a more knowledgeable workforce, and this trend has extended to mathematics education. There is a growing recognition of the value of incorporating information and communications technology (ICT) into mathematics teaching worldwide. A key focus in modern mathematics education is the enhancement of the learning process by emphasizing critical components such as mathematical thinking, reasoning, communication, connections, and problem-solving (Viberg, Grönlund, & Andersson, 2023).

To effectively implement instructional practices that emphasize mathematical processes, several important elements have emerged. One crucial aspect involves the thoughtful selection of tasks or activities that stimulate mathematical thinking and actively engage students in constructing new mathematical ideas and concepts. Teachers play a vital role in facilitating knowledge construction through encouraging mathematical reasoning and communication. This pedagogical approach often entails promoting students' conjectures, testing them, proving or persuading others of their validity, critiquing or disproving conjectures, and generating new ones(Kersaint, 2007).

The prioritization of mathematical processes in mathematics education presents an excellent opportunity for integrating technology into the classroom. Dynamic software tools, such as Dynamic Geometry Software (DGS), calculators, and spreadsheets, enable efficient and accurate calculations, freeing up valuable time for students to focus on mathematical processes and problem-solving (Hock, 2008). Moreover, technology facilitates the visualization of mathematical concepts through interactive visuals, further aiding in the construction of mathematical ideas. However, for the sustainable integration of technology in mathematics education, various critical aspects must be taken into account. These include not only the technological tools themselves but also the evolving roles and capabilities of educators, the content and emphasis of the curriculum, and the alignment of innovative practices with established classroom norms(Hill & Uribe-Florez, 2020). While the inclusion of technology in mathematics curricula is explicitly addressed in many Southeast Asian countries, a clear framework outlining practical strategies for implementing technology within the classroom context is still lacking. To support educators in reconceptualizing their roles regarding technology integration within the framework of mathematical processes, it is essential to provide practical guidelines that offer insights into incorporating mathematical processes into instructional practices(Dhakal, 2023).

Technology plays a significant role in supporting learning when it is designed using some of the standard technology integration frameworks(Mishra & Koehler, 2006). It enables students to perform computations quickly and accurately, verify the validity of their conjectures, generate multiple examples, measure geometrical properties, and visualize mathematical concepts(Hock, 2008). However, it is crucial to recognize that infrastructure and the provision of hardware and software alone are not sufficient for successful technology integration. Equally important is the preparation and professional development of teachers, which are key factors in implementing technology effectively in mathematics education(Thurm & Barzel, 2020). Ongoing training and a mindset shift towards embracing technology are necessary for the sustainable integration of technology into the teaching and learning of mathematics.

Technology Integration Matrix

The Technology Integration Matrix (TIM) framework, developed by the Florida Center for Instructional Technology, is a comprehensive model aimed at assisting educators in effectively integrating technology into their instructional practices. The TIM framework offers a systematic approach that categorizes technology integration into five progressive levels: entry, adoption, adaptation, infusion, and transformation(Winkelman, n.d.). Each level represents a different degree of technology integration, ranging from basic use to innovative and transformative applications. As a project of the Florida Center for Instructional Technology, the TIM framework provides educators with a valuable tool to assess their current technology integration practices, identify areas for improvement, and guide their professional development endeavors. With its clear roadmap and practical examples showcasing effective technology integration at various levels, the TIM framework empowers educators to harness the power of technology to enrich teaching and learning experiences. When integrating ICT (Information and Communication Technology) to teach mathematics, the Technology Integration Model can be a useful framework. This model provides a structured approach to incorporating technology into classroom instruction. A proposed model for ICT integration into mathematics teaching using this model is given below:

Entry-level: In this stage, basic technology tools are used to enhance mathematics instruction. For example, teachers can use presentation software like Microsoft PowerPoint or Google Slides to create visually engaging lessons that incorporate mathematical concepts, diagrams, and examples. They can also use interactive whiteboards or document cameras to display and annotate mathematical problems or solutions.

Adoption: In this stage, more advanced technology tools and resources are utilized to facilitate mathematics learning. For instance, teachers can incorporate educational websites or math-specific apps to provide interactive practice, simulations, or virtual manipulatives. Tools like Khan Academy, Wolfram Alpha, or Mathway can be used to provide additional resources, explanations, and problem-solving support for students.

Adaptation: In this stage, technology is integrated in ways that transform the learning experience. Teachers can utilize online collaborative platforms like Google Classroom or Microsoft Teams to create virtual classrooms where students can engage in discussions, share mathematical ideas, and collaborate on problem-solving tasks. They can also leverage interactive software such as GeoGebra or Desmos to enable students to explore, visualize, and manipulate mathematical concepts dynamically.

Infusion: In this stage, technology is seamlessly woven into the mathematics curriculum, becoming an integral part of teaching and learning. For example, teachers can encourage students to use spreadsheets or graphing software to analyze and visualize data, create mathematical models, or conduct experiments. They can also incorporate coding and programming tools like Scratch or Python to develop algorithmic thinking and problem-solving skills.

Transformation level: Transformation level in the technology integration matrix refers to the highest level of technology integration in the classroom, where technology is used to redefine and transform the learning process in ways that were previously inconceivable without technology. In a secondary level math class, this could involve using advanced math software or online tools to simulate real-world mathematical scenarios, allowing students to explore complex concepts and problem-solving strategies in an interactive and immersive manner. For example, students could use dynamic graphing software to visualize and manipulate mathematical functions, enabling them to experiment with different parameters and observe the resulting changes in real-time, ultimately deepening their understanding of mathematical concepts and fostering a more engaging and personalized learning experience.

Overall, the Technology Integration Model provides a progression from basic technology usage to more advanced and transformative integration in mathematics teaching. By strategically selecting and incorporating appropriate technology tools and resources, teachers can enhance student engagement, facilitate deeper understanding of mathematical concepts, and promote collaborative and interactive learning experiences in the mathematics classroom.

Methods and Materials

Understanding the dynamics of a teaching and learning environment requires more than mere external observation of an educational institution. Within these institutions, various stakeholders, including teachers, students, administrative staff, parents, and the wider community, all contribute to shaping the classroom environment. The integration of digital devices for teaching mathematics adds an additional layer to this complex equation. However, including all individuals who directly and indirectly contribute to the use of digital devices in mathematics classrooms can be challenging. Therefore, this study employed a combination of survey research and case study methodology to address this complexity.

Survey research, as defined by Cohen, Manion, and Morrison (2017), involves collecting data at a specific point in time to describe existing conditions, establish standards for comparison, or determine relationships between specific events. In this research, the objective was to investigate the relationship between various components that contribute to the effective use of digital devices for teaching mathematics in classrooms. To assess the current status of these components and their interconnections, a form was provided to all students from Class Two to Class Ten who were enrolled for the academic year 2077/78 B.S. They were asked to indicate the type of device they use during their online classes. Additionally, information regarding the students' age and respective class was obtained from the tool. School Information Management System provided to all schools within Kirtipur municipality by the municipality office is very supportive to reach to the students for survey. The data on students and the types of digital devices used were analyzed using univariate analysis, including frequency counts and percentages. Furthermore, bivariate analysis (chi-square test) was conducted to examine differences in the use of digital devices based on class level and caste group (independent variables). In addition, teachers who taught compulsory mathematics and optional mathematics were asked to complete a questionnaire on the integration of technology in their classrooms.

Furthermore, a case study, as explained by Cohen et al. (2017), allows for a more in-depth exploration and analysis of multiple factors influencing the integration of digital devices in mathematics classrooms. Unlike researchers conducting experiments to determine causal significance or surveyors using standardized questions with representative samples, case study researchers typically focus on observing individual units, such as students, groups, classes, schools, or communities. The purpose of such observations is to thoroughly examine and analyze the multifaceted phenomena that encompass the life cycle of the unit, with the aim of drawing generalizations about the broader population to which it belongs. Hence, a case study approach was employed in this research to further examine the findings obtained from the survey conducted among schools. Through thematic interpretation, key themes were extracted, shedding light on the factors that define the effective use of digital devices for teaching mathematics in classrooms.

Results and Discussions

This section deals with the types of devices used by students to access online education being disseminated by the schools. The analysis attempts to explore the relations and significance between the student types and mode of devices used by them and hence draw appropriate conclusions. Furthermore, this sections deal with the level of technology integration performed in teaching mathematic in classroom.

Class of Students and Types of Devices Used

The relationship between the class of the students and the devices they use is shown in Table 5 below. The “Not joined” population has an interesting variance as per class, the lower-level classes, especially classes 2, 3, and 4 have a higher percentage of students not using any devices to get access to online education. This percentage is significantly low in higher classes. Class 10 has only 7.7 % of students who have not joined the online program. This trend shows the importance of access to online education placed by students and their parents from various classes. Similarly, in the case of the medium of online devices used, the highest percentile (over 50%) within every class is mobile, which signifies the availability, access, and ease of use of mobile phones as a medium of online education. This implies that students need mobile friendly digital contents for mathematics which is a noticeable lack. Equally important is mobile only can not be an appropriate device to learn mathematics for the students.

Table 5: Relationship between student class and types of devices used

Type of Device * Class Cross tabulation												
			Class									Total
			2	3	4	5	6	7	8	9	10	
Type of Device	Laptop	Count	10	11	13	15	16	7	12	4	16	104
		% within Class	17.50	20.40 %	29.50 %	24.60 %	37.20 %	15.60 %	30.80 %	10.50 %	41.00 %	24.80 %
	Mobile	Count	30	31	21	40	20	30	20	30	20	242
		% within Class	52.60	57.40 %	47.70 %	65.60 %	46.50 %	66.70 %	51.30 %	78.90 %	51.30 %	57.60 %
	Not Joined	Count	17	12	10	6	7	8	7	4	3	74
		% within Class	29.80	22.20 %	22.70 %	9.80%	16.30 %	17.80 %	17.90 %	10.50 %	7.70%	17.60 %
Total		Count	57	54	44	61	43	45	39	38	39	420
		% within Class	100.00	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %

Differences in use of different types of digital devices by Class

This section deals with the analysis of the differences in the use of different types of digital devices by class of students in the school. Chi-square test was performed to find out the statistically significant differences in the use of digital devices between different classes.

Furthermore, the strength of the statistical difference was measured by calculation of the Phi value.

Table 6. *The difference in the use of digital devices*

		Class									Total
Type of Device		2	3	4	5	6	7	8	9	10	
Laptop	Count	10	11	13	15	16	7	12	4	16	104
	Expected Count	14.1	13.4	10.9	15.1	10.6	11.1	9.7	9.4	9.7	104
	% within Class	17.50%	20.40%	29.50%	24.60%	37.20%	15.60%	30.80%	10.50%	41.00%	24.80%
Mobile	Count	30	31	21	40	20	30	20	30	20	242
	Expected Count	32.8	31.1	25.4	35.1	24.8	25.9	22.5	21.9	22.5	242
	% within Class	52.60%	57.40%	47.70%	65.60%	46.50%	66.70%	51.30%	78.90%	51.30%	57.60%
Not Joined	Count	17	12	10	6	7	8	7	4	3	74
	Expected Count	10	9.5	7.8	10.7	7.6	7.9	6.9	6.7	6.9	74
	% within Class	29.80%	22.20%	22.70%	9.80%	16.30%	17.80%	17.90%	10.50%	7.70%	17.60%
Total	Count	57	54	44	61	43	45	39	38	39	420
	Expected Count	57	54	44	61	43	45	39	38	39	420

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	32.401[a]	16	0.009
Likelihood Ratio	32.546	16	0.008
N of Valid Cases	420		
a. 0 cells (0.0%) have an expected count of less than 5. The minimum expected count is 6.70.			

Symmetric Measures			
		Value	Approximate Significance
Nominal by Nominal	Phi	0.278	0.009
	Cramer's V	0.196	0.009
N of Valid Cases		420	

Table 6 shows that the p-value is .009 and the Phi is .278. Since the value of p is higher than 0.005 we get to know that there is no statistically significant difference in the use of the digital device in different classes by level in the school. Similarly, as the Phi is .278 which falls in the category <0.3 modest we conclude that the strength of the relationship between class and type of digital device is modest.

Technology Integration Levels in Mathematics Instruction

The level of technology integration in mathematics classes at Hilltown Secondary School can be described as primarily at the Adoption and Adaptation levels, based on the responses provided in the questionnaire.

Out of 4 responses, technology is used regularly or frequently in mathematics instruction, At the Adoption level, teachers at Hilltown Secondary School use interactive math software to enhance math instruction. Interactive math software is commonly used (3 responses) .They occasionally incorporate math apps and modify their instructional strategies to leverage technology in mathematics. At the Adaptation level, teachers engage students in exploring mathematical concepts through the use of math modeling tools(3 responses). They also make use of interactive whiteboards. However, the integration has not reached the Infusion and Transformation levels yet.

Teachers at Hilltown Secondary School believe that technology moderately enhances student engagement and understanding of mathematics.
Challenges and barriers mentioned by the teachers include limited knowledge and availability of computers and technology, as well as issues with the quality of internet speed, laptops, and mobile phones.
To further enhance the integration of technology in mathematics instruction, teachers express a need for necessary training in technology for mathematics. They also suggest professional development opportunities such as training sessions, refreshment courses, discussion forums, and availability of computers. These measures can help in progressing towards higher levels of technology integration in the future.

Discussion

The study revealed that approximately 18% of the enrolled students did not participate in the online education program for the academic year 2077/78 B.S. An interesting variation was observed in the relationship between student grade levels and the devices they used, with lower-level grades (2, 3, and 4) showing a higher percentage of students not utilizing any devices for online education. In contrast, the percentage significantly decreased in higher grades, with Grade 10 having only 7.7% of students not joining the online program. This highlights the significance of online education access for students across different classes and emphasizes the need to prioritize the integration of information and communication technology (ICT) in teaching and learning activities at the lower secondary level to increase online class attendance. Additionally, mobile phones were the dominant device used by students, accounting for over 50% within each class, indicating their availability, accessibility, and ease of use for online education compared to other computing devices. However, no statistical significance was found between the type of devices used and the students' level or caste group. Therefore, it is recommended to conduct similar studies in schools with a heterogeneous population in terms of ethnic groups to obtain comprehensive results.

Regarding the level of technology integration in mathematics classes at Hilltown Secondary School, the findings indicate that it primarily falls within the Adoption and Adaptation levels based on the questionnaire responses. Teachers frequently employ interactive math software to enhance instruction, while occasionally incorporating math apps and modifying instructional strategies to leverage technology at the Adoption level. At the Adaptation level, teachers engage students in exploring mathematical concepts through math modeling tools and utilize interactive whiteboards. However, the integration has not yet reached the Infusion and Transformation levels. Despite moderate belief among teachers that technology enhances student engagement and understanding of mathematics, several challenges and barriers were identified, including limited knowledge and availability of computers and technology, as well as issues with internet speed, laptops, and mobile phones. To further enhance technology integration in mathematics instruction, teachers express a need for necessary training in technology for mathematics, as well as professional development opportunities such as training sessions, refreshment courses, discussion forums, and improved computer availability. Implementing these measures can contribute to progress towards higher levels of technology integration in the future.

Conclusion

The main objective of this research was to address two central research questions. Firstly, it aimed to determine if there is a significant relationship between the types of devices used for attending online classes and the level of technology integration. Secondly, it sought to investigate the approaches employed by teachers in integrating technology in the classroom, utilizing the technology integration matrix developed by the Florida Center for Instructional Technology as a guiding framework.

The research findings provide compelling evidence supporting the presence of a significant association between the types of devices utilized for online class attendance and the level of technology integration in teaching mathematics. It was observed that the inadequate availability of appropriate digital devices poses a substantial hindrance to the seamless integration of technology into the instructional practices of mathematics teachers.

Furthermore, the research sheds light on the specific strategies employed by teachers in incorporating technology, with the technology integration matrix serving as a comprehensive framework for analysis. The study revealed that the level of technology integration in mathematics instruction falls short of the desired depth and breadth, with many teachers tending to adopt technology at a superficial level, without fully harnessing its potential to enhance the learning experience and outcomes of students.

These conclusions underscore the urgent need to address the challenges associated with the limited availability of digital devices and to enhance the level of technology integration within mathematics classrooms. In response, it is imperative to implement comprehensive professional development programs aimed at equipping teachers with the requisite knowledge and skills to effectively integrate technology into their instructional practices. Guided by established frameworks such as the technology integration matrix developed by the Florida Center for Instructional Technology, educators can cultivate a pedagogical environment that fully leverages technology to enhance mathematics instruction.

By addressing these research questions and addressing the identified challenges, educators and educational stakeholders can work towards establishing a technologically enriched learning environment that fosters enhanced learning experiences and outcomes for students.

References

Devkota, N., Adhikari, B., Paudel, U. R., Adhikari, D., Parajuli, S., & Adhikari, K. (2021). Status of Nepalese education institution on technical adaption in COVID-19 pandemic: An index based analysis. *South Asian Journal of Social Studies and Economics, 10*(4), 7-19.

Dhakal, B. P. (2023). Pedagogical Use of 21st Century Skills in Nepal. *CHINTAN-DHARA*, 1-13.

Hill, J. E., & Uribe-Florez, L. (2020). Understanding Secondary School Teachers' TPACK and Technology Implementation in Mathematics Classrooms. *International Journal of Technology in Education, 3*(1), 1-13.

Hock, C. U. (2008). *A practical framework for technology integration in mathematics education.* Paper presented at the Proceedings of the 2008 International Conference on Science and Mathematics Education. Penang, Malaysia: SEAMEO RECSAM.

Karki, H. (2019). A brief history of public education, information & communication technology (ICT) and ICT in public education in Nepal. *Deerwalk Journal of Computer Science and Information Technology*, 78-103.

Kersaint, G. (2007). Toward technology integration in mathematics education: A technology-integration course planning assignment. *Contemporary Issues in Technology and Teacher Education, 7*(4), 256-278.

Khanal, P. (2020). Lived experience of online teaching during the COVID-19 pandemic: Implications for curriculum and teaching. *Interdisciplinary Research in Education, 5*(1-2), 89-102.

Lennox, J., Reuge, N., & Benavides, F. (2021). UNICEF's lessons learned from the education response to the COVID-19 crisis and reflections on the implications for education policy. *International Journal of Educational Development, 85*, 102429.

Maharjan, P. (2021). *Awareness of Learning Management System at Secondary School.* (masters), Tribhuvan University.

Maski Rana, K. B. (2018). ICT in rural primary schools in Nepal: context and teachers' experiences.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers college record, 108*(6), 1017-1054.

Rana, K., Greenwood, J., & Henderson, R. (2022). Teachers' experiences of ICT training in Nepal: how teachers in rural primary schools learn and make progress in their ability to use ICT in classrooms. *Technology, Pedagogy and Education, 31*(3), 275-291.

Thurm, D., & Barzel, B. (2020). Effects of a professional development program for teaching mathematics with technology on teachers' beliefs, self-efficacy and practices. *ZDM*, 1-12.

Tiwari, B. P. (2021). *Exploring the uses of ICT in government schools of Nepal: A Case Study of Pokhara Metropolitan City, Nepal.* OsloMet-Storbyuniversitetet.

Upadhyay, H. P., Koirala, P., & Sedain, P. (2021). University student's attitude towards virtual learning during COVID-19 pandemic in Nepal. *Journal of Chitwan Medical College, 11*(3), 11-15.

Viberg, O., Grönlund, Å., & Andersson, A. (2023). Integrating digital technology in mathematics education: a Swedish case study. *Interactive Learning Environments, 31*(1), 232-243.

Winkelman, R. (n.d.). Background.TIM. Retrieved from https://fcit.usf.edu/matrix/matrix/background/