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Exploring Perceptions and Challenges of ICT Integration in Secondary Mathematics Education: A Multi-Stockholders' Qualitative Analysis

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Abstract

The study explores perception and problems of integrating information and communication technology (ICT) into the teaching of mathematics at secondary level of Nepal. The qualitative data were collected through four major stakeholder groups: headmasters, municipality (Paalika) education officers, mathematics teacher and secondary-level students. Respondent experiences were acquired through semi-structured questionnaires with open-ended questions, retrieving narrative-rich descriptions of existing practices, opportunities and barriers. Thematic data analysis led to the production of three predominant findings. To begin with, the stakeholders recognized the pedagogical use of ICT as the widespread consensus was based on the factors that explain how this technology can be used in capturing the attention of learners, visualizing abstract concepts in mathematics, fostering problem-solving activities, and increasing instructional options. Second, they still integrate hindrances to effective ICT adoption that include the bad infrastructure, unreliable electricity, lack of digital devices, low quality online resources, as well as inadequate education of teachers. Third, there was consensus on the need to focus on capacity building and systemic support, such as subject-specific teacher training, early ICT literacy among students, better infrastructure at municipal-level, creation of smart classrooms and digital learning portals. Although the potential opportunities of ICT are considerably acknowledged, there is still the issue of concrete integration which is often informal, localized and nothing to be based on the establishment of specific policies. This study provides such contextually and multi-stakeholder evidence that will support the policymakers, town officials, school administrators, and teacher training educators in the Nepalese context to introduce equitable and effective ICT integration in secondary mathematics teaching.

Keywords: *ICT integration, mathematics education, secondary schools, qualitative study, perceptions*

Introduction

The integrations of information and communication technology (ICT) in education has turned out to be an international concern in the furthering of education processes both teaching and learning, especially mathematics, where abstract contents usually bewilder students on their understanding. Analysis programs (e.g., dynamic geometry) or graphing programs, interactive simulations software can offer possibilities to develop deeper conceptual ideas, engagement, and enable differentiation (Trouche & Drijvers, 2014; Viberg et al., 2023). ICT provides exceptional opportunities in secondary mathematics classrooms, where it is possible to visualize, get real-time feedback, and engage in collaborative problem-solving (Abel et al., 2022; Mailizar & Fan, 2021).

The government of Nepal has identified ICT as the means of education enhancement and thus its ICT in Education Master Plan, that will aim at providing schools with infrastructural support, upskilling teachers, and facilitating digital pedagogy. There is however, a complexity of the reality of the implementation particularly in mathematics education. Available research also emphasizes how restricted access to devices, unpredictable internet connection, poor professional development, and strict curricula usually complicate the efficient use of ICT integration (Adhikari, 2021; Naidoo, 2025). Besides, inequalities increase, and a lot of students are deprived of equal possibilities to participate in digital learning, due to differences between urban and rural schools (Dogbey & Kpadin, 2025; Nicholson et al., 2025).

ICT integration in mathematics is a popular research topic that expanded globally; however, most of the studies continue to be quantitative and examine measurable metrics of academic achievement or the rate of technology adoption (Dincc, 2019; Msambwa et al., 2023). Comparative desired absence of qualitative, context-specific research that gives voice to various stakeholders teachers, students, school leaders and policy makers within the Nepal education system. It is important to understand these views given that infrastructure is not the only determinant of the success of ICT integration, but rather, human perceptions, attitudes and situational challenges as well (Arhin et al., 2024; Irakarama et al., 2024).

Thus, study uses qualitative approach to explore the perceptions and challenges associated with ICT integration in secondary mathematics classrooms in Nepal. The study of headmasters, municipal education officers, mathematics teachers, and students' efforts gives a multi-stakeholder data overview of the opportunities and the obstacles of digital pedagogy. The results hope to guide policy, school administrators and teacher educators on how to promote successful and egalitarian use of ICT in math education.

Statement of the Problem

Although the Government of Nepal has made efforts, such as ICT in Education Master Plan, there is still little, unequal, and disjointed integration of ICT in secondary mathematics education. Although ICT is promising in terms of boosting conceptual knowledge, student interaction, and group learning, it is highly hindered by a number of limitations in its practical use. These are poor infrastructure, unreliable electricity, poor internet connection, poor access to devices, incomplete teacher training, and lack of proper implementation of policies (Adhikari, 2021; Naidoo, 2025; Nicholson et al., 2025). Moreover, urban and rural schools digital differences contribute to the widening of the educational gap, as many students will lack equal opportunities in assisting with the learning process through ICT means (Dogbey & Kpadin, 2025).Despite a wealth of global research on ICT integration in mathematics, most of it is quantitative by nature, focusing on the rates of integration adoption or gauging performance but ignoring the experiences and perceptions of the key stakeholders, including teachers, students, school leaders, and policymakers (Dinç, 2019; Msambwa et al., 2023). Also in the context of Nepal, the qualitative

and context-specific research to examine these human and institutional aspects is lacking substantively. In the absence of these insights, there is potential for policymakers and educators to develop strategies that do not represent classroom realities, thus undermining equitable and sustainable ICT adoption; and This study aims to fill this gap by examining perceptions, challenges, and context that influence the integration of ICT in secondary mathematics education using multi-stakeholder qualitative research, aiming at producing evidence-based recommendations for enhancing digital pedagogy as well as bridging the gap between policy and practice.

Objectives of the Study

The main objective of this study is to explore the perceptions and challenges related to the integration of ICT in secondary mathematics education in Nepal through a qualitative, multi-stakeholder lens.

The specific objectives are:

- To examine the perceptions of mathematics teachers, students, headmasters, and municipal officers on using ICT in teaching and learning mathematics.
- To identify the major challenges in integrating ICT into secondary mathematics classrooms in Nepal.
- To explore contextual factors influencing ICT adoption and sustainability in the teaching of mathematics.
- To propose practical, context-specific recommendations for improving ICT integration using the experiences and recommendations of the participants.

These all the above objectives aim to enhance understanding of the human and institutional dimensions of ICT integration, providing rich qualitative insights to complement existing quantitative studies.

Literature Review

Integration of information and communication technology (ICT) in education has been a major seductiveness of educational reforms globally, and the emphasis is on how it paves the way for the progression of conceptual knowledge, interaction, and critical thinking (Abel et al., 2022; Viberg et al., 2023). ICT uses a huge number of tools like interactive whiteboards, computer algebra systems, simulations and internet systems and in the process make the classrooms more participatory and learner-directed. Its effective uptake, however, is largely related to the perceptions of stakeholders, institutional preparedness and situational challenges.

The Technological Pedagogical Content Knowledge (TPACK) framework and the models of digital orchestration emphasize the idea that to effectively use ICT, students need not just technical competence, but that they need to create pedagogically sound, curriculum-related activities. The beliefs and attitudes of teachers have a potent effect on the level and type of integration (Stoilescu, 2014; Trouche and Drijvers, 2014; Dinci, 2019; Arhin et al., 2024).

The attitudes and willingness of teachers are in the focus as ICT is commonly seen as the method to increase motivation, visualize abstract ideas, and provide differentiated instructions (Adhikari, 2021; Mailizar and Fan, 2021). Nevertheless, a lack of training, a deficiency of digital confidence, and institutional support are still important obstacles (Naidoo, 2025; Nicholson et al., 2025). Competence and confidence have been shown to be enhanced by subject-specific pedagogical professional development (Abel et al., 2022; Irakarama et al., 2024).

The students have an overall positive attitude towards ICT, considering that it contributes to active learning, collaboration, and the exploration of information independently (Zamir and Ali,

2023). Yet, inequalities in access to devices, internet connectivity, and teacher support especially in rural schools limit its benefits (Dogbey & Kpadin, 2025).

The institutional and policy forces are also a factor in ICT integration. Adoption is encouraged by leadership, sufficient investment in infrastructure, and strategies and discouraged by insufficient funding, inadequate policies, and insufficient monitoring (Irakarama et al., 2024; Msambwa et al., 2023).

Despite these advancements, significant research gaps persist. Majority of the studies are quantitative in nature and not the lived experiences of the teachers, students, policymakers and administrators especially in developing countries such as Nepal. To study perceptions, challenges and opportunities related to ICT integration, context-specific qualitative research is required (Viberg et al., 2023; Zamir and Ali, 2023).

Methodology

This study was qualitative in nature by seeking to understand the perceptions and challenges related to the introduction of information and communication technology (ICT) in mathematics education in secondary schools in Nepal (Creswell and Poth, 2018). The method enabled a deep interpretation of the experiences, attitudes and realities of context that participants face but is not considered in quantitative studies. The research was carried out in two municipalities chosen because of their different educational settings in that Madhyapur Thimi in Bhaktapur District (Bagmati Province) has comparatively good education facilities whereas Harion in Sarlahi District (Madhesh Province) reflects resource-constrained environments. To achieve a wide range of insights on pedagogical, institutional and policy levels, eleven participants were purposely identified based on four stakeholder groups, such as two mathematics teachers, five students, two headmasters, and two municipal education officers.

Semi-structured questionnaires that included open-ended questions were used to collect data that sought to create detailed accounts of the experiences of participants in teaching and learning mathematics using ICT, their perceived benefits of ICT, challenges and suggestions on how ICT could be improved. The open format has allowed each group of stakeholders to provide responses in detail and context-specifically. Thematic analysis was performed on the gathered qualitative data along the 6 steps of the framework developed by Braun and Clarke (2006). The responses were read with care to familiarize with them, coded inductively and organized into larger themes that included perceived benefits, infrastructural barriers, the need to develop professionally and gaps in the policy. Data were tabulated and managed in Microsoft Excel and quotations of participants added to facilitate interpretation and to generate authenticity.

Triangulation between the perspectives of stakeholders and member checking was used to provide confirmation to the findings to ensure credibility. The ethics was approved and informed consent was collected. Pseudonyms were employed in order to preserve confidentiality, and surnames were given in accordance with the traditional cultural pattern. The principles of beneficence, respect and justice were strictly followed in the study.

Results and Discussion

In these sections the findings of eleven participants two municipalities Madhyapur Thimi of Bhaktapur District (Bagmati Province) and Harion in Solahi District (Madhesh Province) are presented. The respondents division consisted of two headmasters, two municipal workers, two mathematics lecturers and five students (three of Bhaktapur and two of Sarlahi). In all cases I use pseudonyms (false names followed by caste) to preserve anonymity. These results are categorized into stakeholder groups thematically.

Headmaster's Perspective

Ram Shrestha and Hari Thapa, the headmasters of two secondary schools (in Bhaktapur and Sarlahi), gave their thoughts on the topic of ICT and mathematics teaching. It was on consensus when both agreed that the adoption of ICT is very early. Although some effort of applying technology in teaching has been exerted, ICT is yet to be a regular or habitual routine in the daily classroom activities.

Ram Shrestha has noted that ICT has already impacted positively on student motivation and inquisitiveness despite its limited implementation. According to him, *"Students have developed greater interest in learning."* Likewise, Hari Thapa mentioned that, even incidental interaction with ICT serves to make students more involved and less fearful of mathematics, in particular at operating with the abstract issues.

The preparation of teachers also was highlighted by both headmasters as being the most important issue. Ram Shrestha observed that, *"We have realized the need for ICT-based training,"* and Hari Thapa concurred that most mathematics teachers are not very comfortable with the effective use of digital tools. In as much as the two schools have planned professional training sessions, it is still in the stage of intention, not fully implemented: *"We have made plans to conduct training."*

Moreover, neither of the two headmasters insisted that basic knowledge of ICT is sufficient in teaching mathematics. They concurred that instructors need to be trained specifically on software like GeoGebra, graphing, and mathematical modelling software. Ram Shresth as noted, "*There is a need for training in handling mathematical tools."*

When their views are combined, they provide evidence of a common interest in the possibilities of ICT but a recognition of systemic issues, especially in the area of a lack of sustained and subject-specific professional development in relation to mathematics teaching.

Paalika Officers' Perspective

Two of the municipal education officers involved in educational programs were Deepak Thapa and Hari Magar with whom they continually underlined the concept of ICT as a strong strategy on advancing mathematics education. Deepak Thapa said, "*Use of ICT helps improve the quality of mathematics education* ". Pointing out that digital learning tools improve the interactivity of instruction and add some meaning. And Hari Magar said ICT has been particularly helpful in the formation of how students learn: *"Real time feedback – Real time growth. Faster learning"* .This view emphasizes on how ICT may be used to hasten learning as it will offer instant feedback, errors and directions to learners throughout the process of learning.

The officers have pointed out visualization and retention as per the request of a specific benefit. Deepak Thapa observed, *"ICT helps students understand concepts and increases their interest in mathematics"* .This is strengthened by Hari Magar who says, of the process, *"Improved visualization of concepts and increased student engagement."* Such answers imply that the role of ICT is viewed not only as a supplement but as a differentiating tool to simplify and attract mathematics to students.

Although enthusiastic about it, both officers also admitted that schools in their municipalities have systemic challenges. They kept the total number of issues in a broad description that includes a lack of an educated teaching workforce, insufficient physical conditions, and poor access to digital resources. Deepak Thapa was brief on this point: *"Lack of teacher skills, absence of infrastructure, and shortage of digital resources."* Such impediments imply that although municipalities are cognizant of the potential of ICT, they have been neglected and semi-consistent in implementation.

The officers also explained steps that have already been taken. Cities have begun to roll out digital classrooms and specific teachers have gained ICT training. As an example, Hari Magar highlighted, *"Introduction of digital classrooms and ICT training for teachers."*. In the future prospects, they had generous proposals of having the fully equipped smart classrooms and constructing teacher assistance and resource sharing portals on the internet. Deepak Thapa outlined this vision as, *"Fully equipped smart classroom. Build teaching portal for teachers."* One other one was, *"Development of ICT infrastructure, teacher training, and creation of learning portals."* These answers indicate that although the task is far from accomplished, cities are trying to bridge the gap that exists between the dream and the reality of the classroom.

Students' Perspective

Students like Raju Tamang, Maya Thapa, Sita Magar, Hari Shrestha and Anita Rai mostly explained the use of ICT to support their studies in mathematics as an occasional and complimentary activity, but not a fully integrated part of classroom teaching. They stated that their primary tools were mobile phones, computers and internet searches, frequently to find answers to a particular problem. According to Raju Tamang, this was how the practice was straightforwardly explained: *"it is based on the ability to see question and then solve it".* Although this form of use depicts that it is a restricted type of use, it equally represents that, ICT can provide urgent assistance towards solving of problems beyond the confinement of the conventional classroom.

Some students emphasized that ICT made mathematical concepts that were tough to understand clear. Maya Thapa said, *"It helps to clear the concept,"* and Sita Magar said, *"When I watch a video about a theorem, it feels clearer than just reading from the book."* These are just remarks that demonstrate that students have realized that ICT is a method of making abstract content visual and understandable especially in certain subjects like geometry and algebra.

But there are several frustrations and obstacles that students identified also. This was a complaint by Hari Shrestha that it was not always easy to find good reliable resources: *"The exact topic I am searching for is not easily found."* Raju Tamang reported issues with distracting ads, with the one word, "Ads." Maya Thapa also complained about confusing materials with, *"Not getting the exact concept."* Anita Rai gave a concrete example of lack of device availability; she explained: *"It is difficult when I don't have a laptop."* All these observations show that ICT is a great opportunity, yet at the same time in many cases, unequal access and unmoderated online information make this tool less productive.

When we questioned them in the effort of finding solutions to these problems, the majority of them indicated that they consulted teachers, peers or would search again on the internet. Sita Magar said, *"If I don't find it, I ask teachers or friends in class."* This implies that teaching and learning in a classroom cannot be replaced by ICT but serves best as an addition with a teacher's guide and additional reinforcement by fellow learners.

Finally, students came up with suggestions on how ICT can be better integrated. Maya Thapa recommended that ICT must be taught as early as possible and familiarity will be created with time. She emphasized, *"It should be taught from basic classes onwards."* Anita Rai indicated that teacher preparation was important, and said, *"First of all, teachers should be given training on ICT."* These observations clarify the fact that students do not view ICT as a convenience only but as a tool that has the potential to fundamentally transform the learning of mathematics, in the event that it is used in a systematic manner.

Teachers' Perspective

The experience of teachers like Kiran Rai (Bhaktapur) and Maya Tamang (Sarlahi) was more coherent with ICT application than those of students, but their reports still verified that ICT integration is incomplete and not properly developed. They explained such tools as YouTube videos, 3D models, GeoGebra, multimedia presentations. According to Kiran Rai, *Sometimes I show YouTube videos related to the lesson and use 3D models."* Maya Tamang also stated that she utilized the software of GeoGebra. These two cases indicate that educators are actively striving to use the technology as a part of their lessons, but there have been limitations.

It was also evident to the teachers on the benefits they saw. ICT enabled them to make mathematical concepts more pictorial, arouse the student's curiosity and use a variety of examples. This was summarized over by Maya Tamang, *"Students learn with curiosity and enthusiasm."* Kiran Rai continued to add that *"Concept can be visualized."* These remarks establish the fact that teachers also understand ICT as a means of enhancing teaching rather than a form of abstract exposition into concrete, interactive learning process.

They also found several key hurdles at the same time. These were power cuts, unavailability of smartboards, low digital competence and the additional time consumed in getting ICT-based lessons ready. Kiran Rai said, *"Problems of electricity shortage and lack of smartboards."* Maya Tamang said, *"Maybe lack of ideas operating them and lack of training."* These considerations foreground the manner in which structural deficiencies in infrastructure and training make it impossible to take full advantage of ICT as a means of enhancing the practice of teaching.

Although the teachers had these challenges, they exhibited individual effort in attempting to address them. Kiran Rai explained how as a method of securing access he had bought his own laptop, saying, I bought my own laptop. Maya Tamang described how she consulted more technically competent workmates: I consult with technical persons. These tactics depict their determination as well as the pressure on individuals when a necessary support is lacking at the institutions.

On identifying what additional training would make ICT more effective both teachers responded that they needed a thorough professional training, access to e-libraries and availing of ICT resources in schools. Maya Tamang observed,*"All ICT tools should be available in schools, and teachers should be trained."* Kiran Rai also contributed, including: *"E-library, access to appropriate websites and training."* These answers imply that the teachers not only perceive the usefulness of ICT, but also have a concrete idea of the fundamental changes, which need to be implemented within the system, to ensure that ICT integration is sustained.

Cross-Stakeholder Themes

Collectively, the voices of Ram Shrestha (headmaster, Bhaktapur) Hari Thapa (headmaster, Sarlahi), Deepak Thapa, Hari Magar (municipal officers, Bhaktapur and Sarlahi), Kiran Rai (teacher, Bhaktapur), Maya Tamang (teacher, Sarlahi), student Raju Tamang, Maya Thapa, Sita Magar, Hari Shrestha and Anita Rai exhibit three intertwining themes that cut across all stakeholder groups.

To begin with, it was the pedagogical value of ICT that attracted attention of all stakeholders because, at that, ICT was perceived as a means to engender interaction and model abstract mathematical ideas. As an illustration, Kiran Rai argued, that it is possible to visualize concept, and Maya Thapa (a student at Bhaktapur) stated, that it assists in clearing the concept. In a parallel way, Sita Magar stated that videos helped me understand theorems and Raju Tamang mentioned that ICT tools could be used directly related to problem-solving activities. Anita Rai

said further that ICT not only supported in clarifying learning but also provided her with the desire to stick to mathematics. Both headmasters also pointed out that ICT also promoted curiosity among students even when used in a modest way. Taken together the views indicate a universal appreciated understanding that ICT enhances teaching and learning.

Second, the outstanding issue of ICT adoption is systemic impediments. The predicament on limited infrastructure, unreliable electricity, inadequate devices, and the unavailability of teacher training were identified by the stakeholders as recurring as well. The teachers explained they have a problem with poor digital literacy and no smartboards at all, whereas students provided graphic reports of their trouble. Anita Rai said that she did not have a laptop, Hari Shrestha complained that finding credible sources online is associated with problems, and others noted the presence of distractors such as adverts or opaque explanations. Municipal officers said that even with programs like the use of digital classrooms they were not yet in a position to offer the ICT support to an equally desired number of schools. Head masters also indicated that although they had strategies on training, they had not been realized since they lacked resources. Such reports provide evidence of the fact that the interest in ICT is balanced by the line of structural barriers.

Third, across the groups there was a consensus on capacity building and systemic support. The stakeholders stressed numerous times on professional teacher training, equal supply of ICT resource and more pronounced institution frameworks. Learners argued that teachers were the first to be trained; Maya Thapa and Sita Magar reiterated that ICT literacy needed to commence at the lower grades. Anita Rai further adder that the competency of teachers, leaves students unable to enjoy ICT to optimum. The two headmasters were in accord that subject-level training, in particular the mathematical tools, was a key. Municipal officials like Deepak Thapa and Hari Magar articulated visionary plans of smart classrooms, better digital infrastructure and internet-based learning platforms and portals to teachers and students.

In short, despite the high value placed on ICT, the incorporation of ICT into Nepal secondary mathematics teaching has been patchy and localized, frequently not well integrated but a matter of personal initiative and not part of a systematically embedded school-wide programme. Together, the stories of students, teachers, headmasters and municipal officers bring out the potential and the prevailing limitations that determine the current state of mathematics classrooms in Nepal when it comes to the use of ICT.

Discussion

The findings indicates that the adoption of ICT in Nepalese secondary mathematics education was in its infancy and disjointed, even though its pedagogical possibilities were widely recognized. It was found that ICT was a useful tool in increasing engagement, simplifying abstract concepts, and learning collaboratively, with stakeholders (such as headmasters, municipal education officers, teachers, and students) identifying it as such. Videos, interactive simulations and online tutorials, in particular, were found by students to be extremely useful when studying complex concepts such as theorems and algebraic transformations, whereas teachers found the tools such as GeoGebra, multimedia presentation and 3D model especially useful in visualizing mathematical processes.The results are consistent with the international literature that proves the effectiveness of ICT in motivating students, differentiated instruction, and deeper conceptual learning (Abel et al., 2022; Viberg et al., 2023; Trouche and Drijvers, 2014). It is not, however, an acknowledgement that in spite of this collective acknowledgement of the benefits of ICT, systemic and structural impediments still curtail the meaningful incorporation of ICT.

The participants always cited the lack of sufficient infrastructure, unstable electricity, low access to devices, and inadequate internet connectivity as key problems, especially in rural and

resource-limited regions (Naidoo, 2025; Dogbey and Kpadin, 2025). Inadequate institutional support has caused teachers to depend on personal devices and self-funded resources when they should, and the students to experience inequalities in having access to digital tools, resulting in uneven and unfair integration in the classroom. There were also gaps in competence among teachers, and most of the teachers were not confident in the ability to use ICT effectively. There are still limited opportunities when it comes to professional development, and even training programs tend to be very focused not on the adoption of ICT in pedagogically sound, subject-specific approaches but on the acquisition of limited technical skills. These results align with the previous studies in Nepal because teacher preparedness is already found to be a key determinant of ICT success (Adhikari, 2021; Abel et al., 2022).

Policy and institutional shortcomings further compound these challenges. Although municipal officers have been keen on the proliferation of smart classrooms, online learning portals and the enhancement of teacher training, there has been a sluggish and uneven implementation process. The hopes of the ICT in Education Master Plan of Nepal have not been met because of lack of funds, proper monitoring and accountability (Msambwa et al., 2023). Consequently, the adoption of ICT in mathematics classrooms is usually at an individual level and not necessarily universal institutional support, resulting in inequality between schools and municipalities.

Overall, the findings make a strong case for concerted action among stakeholders to build infrastructure, scale-up teacher capacity through mathematics-related ICT training and early ICT literacy among learners to close digital divides. Classroom realities should be more appropriately aligned with policy frameworks so that they can be sustained and fair. This research provides an important addition to the qualitative literature on ICT integration in revealing how ICT's transformative potential for the advancement of mathematics education in Nepal will only be fulfilled if the potential investments are evenly spread across infrastructure, human capacity, and stable policies.

Conclusion

This study explored the views and issues of ICT integration in the teaching of mathematics in the secondary schools in Nepal based on the views of the headmasters, municipal officers, mathematics teachers and students, as a case study within a qualitative design. The results showed a high level of knowledge about the pedagogical usefulness of ICT and its impact on improving the engagement and interest of students, the visualization of abstract ideas, and an increase in the interactivity of learning activities. Meanwhile, major challenges were also identified, such as ineffective infrastructure, unreliable electricity and internet connectivity, inadequate teacher education, and the ongoing disconnect between policy ambitions and classroom practice.

The research also indicated that ICT integration has not been implemented uniformly, although its concept is appreciated. Many municipal programs see smart classrooms and digital portals, but at the school level, integration majorly relies on the actions of individual stakeholders, like teachers buying laptops independently or pupils seeking out online resources on their own. This highlights the structural mismatch between national or local policy aspirations and the feasibility of schools to implement them.

This study adds to the qualitative body of research regarding the role of ICT in teaching by allowing the triangulation of various stakeholder perspectives on the matter to emphasize the experience of people directly involved in the integration process. Puts the Nepalese case in the context of global discussions about digital pedagogy, highlighting that the transformative potential of ICT for teaching mathematics can only be delivered if a balance is maintained between investments in infrastructure, teacher capacity and policy coherence.

Recommendations

This study has significant policy, practice as well as research implications in the context of ICT integration in secondary mathematics education in Nepal. At the policy level, sustained investment in ICT infrastructure is critical, especially in rural and poorly resourced schools, for reducing inequalities in access. Clear monitoring and accountability structures should be implemented in the ICT in Education Master Plan to monitor schools to ensure that they get the planned school resources and facilities. Additionally, an integrated approach to strengthening early ICT literacy programs at lower education levels will enable students to build foundational digital competencies prior to learning and engaging with advanced mathematics applications at the secondary school level. At the school level, heads should arrange for professional development programmes that are specifically related to mathematics-specific applications of ICT, such as dynamic geometry applications, interactive simulations and digital assessment tools. Such programs must extend beyond technical training to incorporate pedagogical approaches that can guide successful incorporation of ICT in lesson planning and curriculum delivery. Peer-learning networks across and within schools may further support innovation, resource sharing, and continuous teacher support. In order to open up ICT integration to not substituting a process of instruction, teachers need a systematic support to build their Technological Pedagogical Content Knowledge (TPACK). Teachers can use continuous mentoring and chances of learning how to use ICT tools to make them meaningful learning opportunities to the students. Lastly, the study needs to be extended by examining how the inclusion of ICT should and actually influence student learning over time in mathematics, as well as to examine how the gap between policy intentions and classroom-level implementation can be mediated in the future. The in-service and pre-service education ought to focus on the use of technological equipment beyond merely how they are technically used but in the planning of lessons, the organization of classrooms and evaluation in the technology-abounding classes. On the same note, provision of blended learning where ICT and conventional teaching are harmonized to address variety in the needs of learners is right on point.

On the learner level, pathways to equitable access are still important to create. Schools may introduce the lending schemes of the devices or community ICT centers, or work with municipalities to allow access to the digital resources. Creating localized, relevant, student-centered networked materials on topics of the mathematics curriculum that are curated and free of commercial clutter would help exert control over the chaos of unstructured online information that bothered the students. Enhancement of digital literacy would, additionally, allow the students to have better inner resources to critically filter information and make the best use of ICT in real-life situations, as opposed to passively orienting to it.

Lastly, integration of ICT must be achieved through constant cooperation between municipal officers, school leaders, teachers, and students. Having review forums on regular basis, formation of localized mathematics resource banks would make sure that the initiatives are sensitive to local needs and sustainable in the long run.

Directions for Future Research

In future, this research needs to have a wider scope by covering large areas or regions to accommodate diverse differences in integration of ICT in individual municipalities. It is also possible that comparative studies of rural and urban schools would provide useful information on local problems and solutions, whereas longitudinal studies would enable the researcher to evaluate the long-term consequences of the long-term investments (its infrastructure and professional development of teachers). ICT would also have a more balanced picture of the effects of ICT in mathematics education by using mixed- methods research that incorporates both qualitative views

regarding the effects of ICT using qualitative assessment of achievement levels of students in mathematics education.

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