

Effect of Teachers Problems in Using Digital Resources on Mathematical Content Instruction Online

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Abstract

The aim of the research was to find the effect of the problems of mathematics teachers in teaching mathematics online on instructing mathematical content. A cross-sectional online survey design was employed among 258 secondary-level mathematics teachers in Nepal. Path analysis model under structural equation modeling was the major statistical technique used in the research. The finding indicates that the problems of mathematics teachers in internet surfing, class control, interest in online courses, and digital content development are major contributing factors to instructing mathematical content online.

Keywords: ICT, mathematics, mathematical content, Nepal, problem

1. Introduction

COVID-19 pandemic presents challenges as well as opportunities to educational activities (Adhikari et al., 2022; Joshi, Khanal, & Dhakal, 2023; Joshi, Neupane, et al., 2023; Khadka et al., 2022; Khanal, Joshi, Adhikari, & Khanal, 2022; Khanal, Joshi, Adhikari, Khadka, et al., 2022). In the starting day of pandemic, it puts our education system at risk and it makes compulsion to think their stakeholders. Teachers were agreed to run online classes and in panic they started classes without enough planning and preparation. As a result, educational institution, teachers as well as learners faced so many problems in the online teaching environment such as ICT infrastructure (Adarkwah, 2021), difficulty controlling the class, unnecessary noise in the online classes, difficulty monitoring student's activities during online class, and internet connectivity (Adhikari et al., 2022). Hence, teachers needed the knowledge and abilities to efficiently traverse them in the online environment. In this sense, it offers the opportunities to learn through technologically based learning for educational institution.

Digital resources have contributed to a revolution in the field of education and others (Belbase et al., 2022; Joshi, D, 2017; Joshi & Bhandari, 2016) including changes in human behavior (Joshi et al., 2019; Joshi, Adhikari, et al., 2022; Joshi, Khanal, et al., 2022; Joshi, Neupane, Singh, et al., 2021; Joshi, Singh, et al., 2021). Many chances are created by Facebook, YouTube, WhatsApp, and other media, which also change mental processes and

learning preferences (Hidayatullah & Suprapti, 2020). Additionally, it has had an impact on educational policy, instruction, and evaluation of the mathematical learning process (Joshi, Singh, et al., 2021; Neupane et al., 2020). Mathematical classrooms are becoming more technologically advanced. Hence, teachers need digital skills and abilities to efficiently their effective implementation in the classroom (Joshi, Neupane, & Joshi, 2021; Joshi & Singh, 2020; Khanal et al., 2021). Olatokun (2008) claims that in the view of high schools' students' internet access and its uses are superior and more practical than their school libraries and internet is a source of general knowledge which supported in the development of their reading habits and academic achievement. Due to the prevalence of using the internet as an online learning resource, students' academic results have improved (Siraj et al., 2015).

Mbongo et al. (2021) revealed that adopting online teaching and learning has advantages such as flexibility, teaching vast courses, and enhanced contact and engagement between lecturers and students, all of which were made possible by the internet. Hence, the internet surfing has an impact on students' academic standards. Students who use it on the right way showed a greater improvement in their grades than those who don't (Amponsah et al., 2022). Online learning is an opportunity in higher education for job holders and married women as well as others who could not join face to face classes in the context of Nepal (Dhakal, 2022). It enables them to access various resources of studies their publications and articles that would not available in libraries. However, unnecessary uses of internet can results the distraction of time and student can wasted time on social media rather than studying (Affum, 2022). Hence, the presence of several sources of internet connectivity may not be guaranteed to enhance academic performance. Therefore, Amponsah et al. (2022) suggested that students should be taught how to use search engines to search online for academic materials and Affum (2022) suggested that educational administrators should provide instructions to assist students in overcoming some of the difficulties encountered when utilizing the internet. The students with a positive self-concept in mathematics are more optimistic about their chances of passing the course, showing interest in learning and performing well overall in the course. They are more likely to attend classes, complete their assignments, assist their classmates with their assignments, remember lectures, and do well in class, however students have negative notions of their mathematics self-concept in terms of understanding the lesson, solving problems, finishing the course, performing better relative to their classmates, and enjoying the online class (Bringula et al., 2021).

Due to the pandemic all the educational institutions of various countries including Nepal started online teaching learning activities in the lockdown (Dawadi et al., 2020). Hence face to face classes were replaced by virtual learning and it was also true for mathematics classes. The fundamental principles of social justice in mathematics includes equity and fairness, among other concerns with teaching and learning (OECD, 2012). However, all students have not equity and fairness in access to technology in the context of Nepal due to their economic condition. In Nepal, the same curriculum has been taught for a very long time, which creates an imbalance between what education offers and what society needs, which causes students in anxiety and lead themselves as math failures (Luttenberger et al., 2018). Teachers in this situation must to be skilled at utilizing new technical tools in addition to their knowledge of subject matter and pedagogical strategies. It is a significant issue to prepare instructors for the modern mathematics classroom from the perspective of technical awareness (Keser & Sari, 2021). It implies that the majority of mathematics teachers are not technologically knowledge enough. Information and communication technologies are at the heart of the teaching and learning process, particularly in mathematics (Al-Hilli, 2019).

However, determining which technology tools are appropriate for the subject being taught and in accordance with the proficiency of the students has always been difficult.

Mathematics courses contain mathematics modeling, formulae, symbols, figures and algorithm. School level curriculum of Nepal included arithmetic, mensuration, algebra, trigonometry, geometry, probability and statistics in compulsory mathematics course as well as it also included the area like vector, transformation, linear programming, numerical analysis etc. in the Optional mathematics (CDC, 2019). The main challenge in teaching online is dealing with algebra, algebraic variables, and their operation, especially in higher education (Prameshti & Retnawati, 2019). The inability of tutors to write mathematical symbols, using software, and writing mathematical symbols are all significant obstacles to online learning (Irfan et al., 2020). Hence, to teach mathematics effectively technology should be supportive and teachers require to have sufficient skills of using digital resources (UNESCO, 2016). To make effective and interesting mathematics online classes school teachers requires presentation skills (Yohannes et al., 2021). A survey conducted by Drijvers et al. (2016) revealed that teachers' technological-pedagogical knowledge had a significantly positive effect on student achievements in both algebra and geometry in traditional face-to-face classes. Unfortunately, due to long-standing traditions of face-to-face classroom education, previous research (Joshi, Chitrakar, Belbase, et al., 2021; Khanal et al., 2021) shown that teachers of Nepal, particularly those at the university level, have less expertise using online resources in mathematics. The results of the survey conducted by Mubasher Hassan et al. (2020) indicate that teachers are facing technical difficulties in using online platforms for delivery of instruction as well as in creating e-content due to their lack of computer skills required for online teaching as well as creating digitalized material for teaching. Joshi (2019) indicates that the investment in digital resources in educational institution, awareness and training programs for mathematics teachers are not sufficient in the context of Nepal. Although the online mode was already in place and was used in blended form to a significant extent in developed countries, in developing countries like Nepal, teachers have lack of knowledge and skills to manage the online ICT infrastructure in a challenging situation because they are not familiar with online platforms/tools. Hence, it is necessary to focus on the digital literacy skills, proper guidelines or trainings on the use of online tools/platforms for online teaching and e-content creation for professional development (Mubasher Hassan et al., 2020).

Studies focuses on the mathematics teaching and related problem during online teaching such as teaching-learning issues in mathematics (Panthi et al., 2021), challenges faced by the learners (Dhakal, 2022), factors associated with the challenges in teaching mathematics online (Adhikari et al., 2022), problem of mathematics teacher in teaching mathematical content online (Khanal et al., 2022), teachers' Perceptions on effect of information and communication technologies (Joshi, 2021), teachers' perceptions toward student support in using information and communication technology in mathematics learning (Joshi et al., 2022). Khanal et al. (2022) indicate that Algebra, Statistics, Vectors, Geometry, and Analysis are problematic areas for teachers teaching mathematics online and other mentioned above literature focused on the effect of using digital resources teachers' professional development and learning performance in the context of Nepal. However, there is no literature what impacts occur when the teachers' problems rise in using digital resources on mathematical content instruction online. Hence, this study is needed to find the effect of the problems of mathematics teacher on their mathematical content instruction during online classes. Additionally, the focus of the above literature is in different context however this study is in the context of Nepal which also the represents the developing country context.

In this context this study will be helpful to know the impact of handling the ICT resources on mathematics content on online teaching and improve the online environment with mathematical content. This study is limited to the COVID-19 pandemic situation. However, it is equally applicable in the future in normal situations to practice of the blended mode of instruction.

2. Methodology

The data were collected through online during COVID-19 pandemic hence cross-sectional survey design was applied in the research. The study was carried out among 258 mathematics teachers (Male 93% and female 7%) of secondary level in Nepal. The data was collected from August to December, 2020. The survey tool was shared to 1572 mathematics teachers (through their email) of different level because of not identified their level in the list however only 258 mathematics teachers of secondary level were participated in the research hence list-based sampling (Fricker, 2017; Schonlau et al., 2002) technique was applied in the research. The data was collected through Google Form.

2.1 Variables Information

Three sample characteristics were used in the research as gender, qualification, and job type. The gender has two categories as female (7.0%) and male (93.0%), qualification has two categories as up to bachelor (15.9%) and master and above (84.15) whereas job type has two categories as permanent (51.2%) and temporary (48.8%). More detail of the sample characteristics is presented in Table 1. Additionally, six problems of mathematics in teaching mathematics online as internet surfing, content development, interest in online course, course management, class controlling skills, and content surfing were measured in five-point rating scale from strongly disagree to strongly agree. Furthermore, the problems of mathematics teacher in teaching Arithmetic, Algebra, Geometry, Trigonometry, and Statistics were also measured in five-point rating scale from very difficult to very easy. The detail of the variable information is presented in Figure 1.

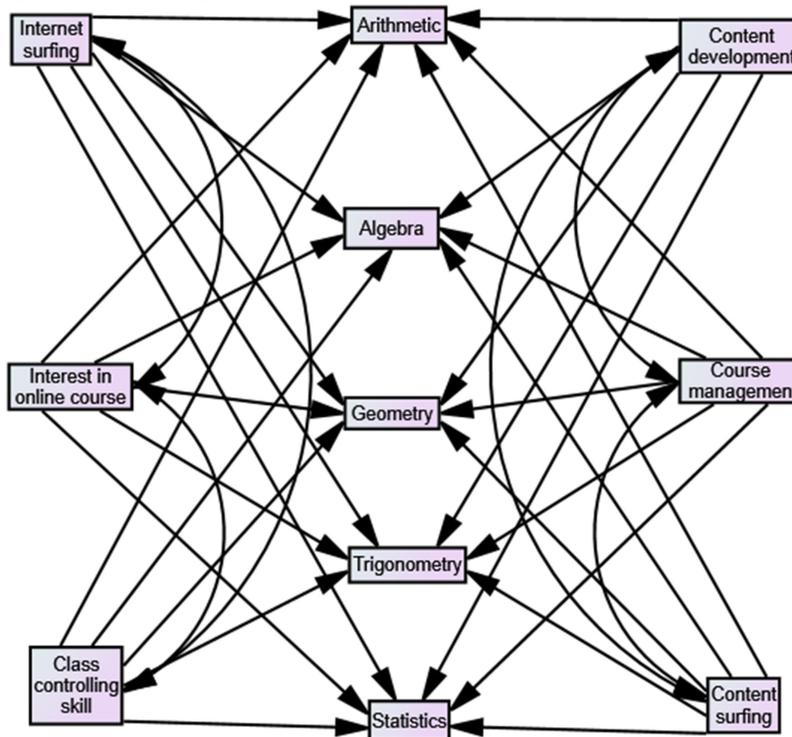


Figure 1: Conceptual framework

Table 1: Sample Characteristics (n=258)

Variables	Categories	Frequency	Percentage
Gender	Female	18	7.0
	Male	240	93.0
Qualification	Up to Bachelor	41	15.9
	Master and above	217	84.1
Job type	Permanent	132	51.2
	Temporary	126	48.8

2.2 Data Analysis Technique

The process of data coding, cleaning, and validation was managed in Statistical Package for Social Science (SPSS 26), however AMOS software was used to find the result. The data were analyzed by using path analysis technique under structural equation modeling (SEM) in the AMOS to find the answer of research question. The data were analyzed based on the different categories of sample characteristics including in total sample like gender (Male), qualification (Up to bachelor and master and above), and job type (Permanent and temporary). The analysis based on female was excluded because of poor participation of female in the sample. Different assumptions of path analysis like linearity, multi-collinearity, normality were tested before analysis (Nayebi, 2020).

3. Results

In total sample the model explains 7%, 4%, 11%, 12%, and 11% of variances in Arithmetic, Algebra, Geometry, Trigonometry, and Statistics respectively, however that variance found to be 7%, 3%, 12%, 14%, and 12% with respect to male participants, 25%, 16%, 41%, 20%, and 27% with respect to up to bachelor qualification, 5%, 5%, 8%, 13%, and 11% with respect to master and above qualification, 8%, 1%, 11%, 8%, and 16% with respect to permanent teachers, and 7%, 8%, 14%, 18%, and 9% with respect to the temporary teachers which indicating that the model found to be better fit with respect to the teachers having up to bachelor qualification.

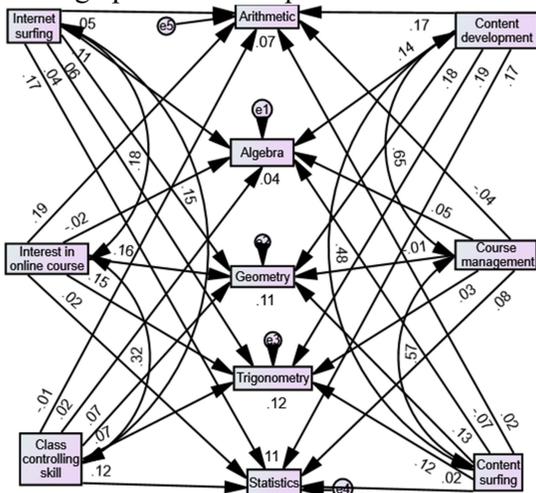


Figure 2: Results based on total sample

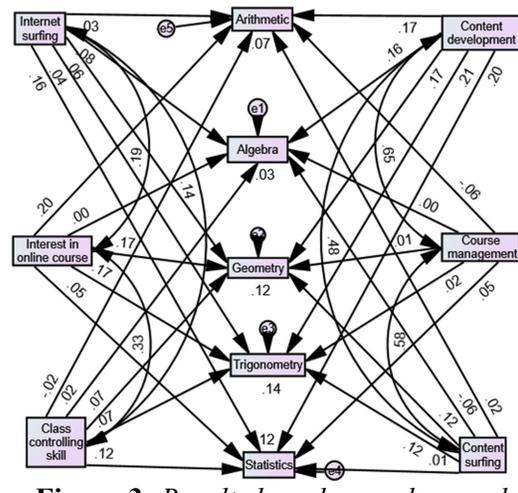


Figure 3: Results based on male sample

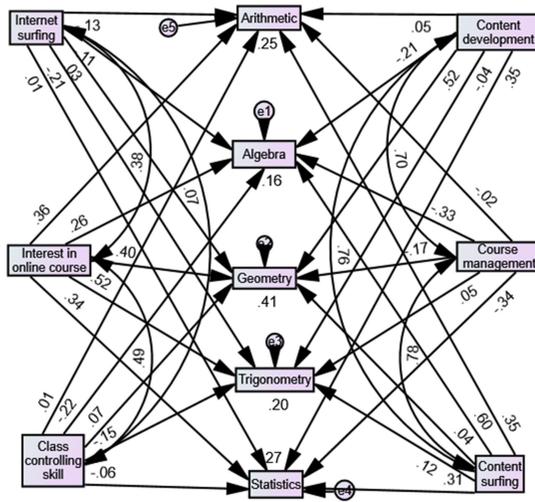


Figure 4: Results based on up to bachelor qualification

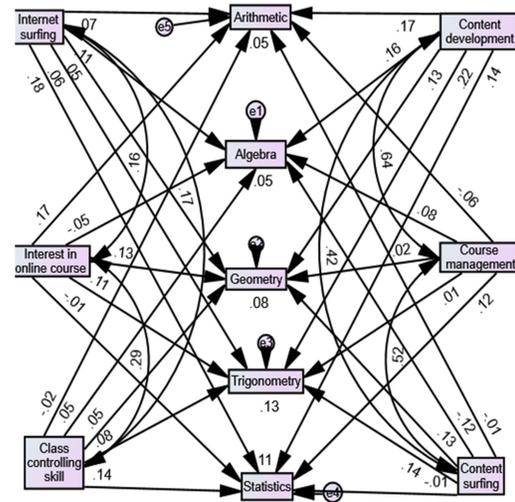


Figure 5: Results based on master and above qualification

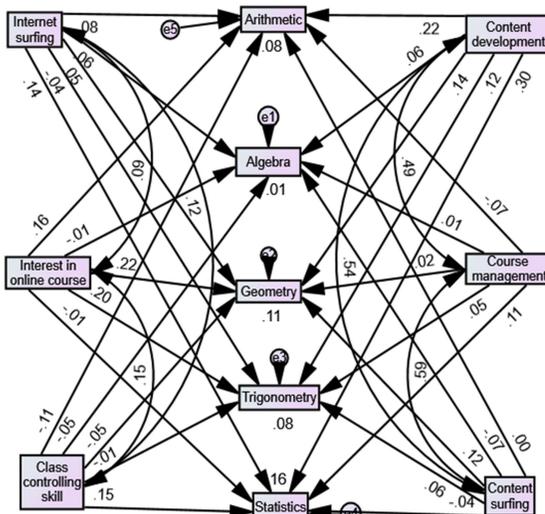


Figure 6: Results based on permanent teachers

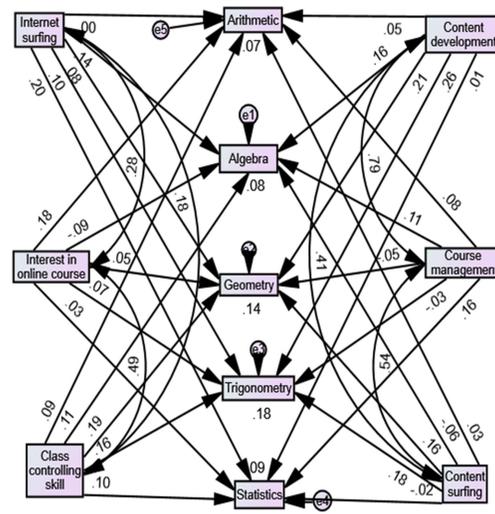


Figure 7: Results based on temporary teachers

Figure 2-6 and Table 2 shows that the interest of teachers in online course found to be significant predictor in teaching Arithmetic with respect to total sample (Beta=0.19), male (Beta=0.20), up to bachelor qualification (Beta=0.36), master and above qualification (Beta=0.17) and permanent teacher (Beta=0.16). Similarly, content development found to be significant predictor to the Arithmetic with respect to total, male, master and above qualification (Beta=0.17), and permanent teacher (Beta=0.22). Content surfing (Beta=0.16) with respect to up to bachelor qualification and content development (Beta=0.16) with respect to male found to be significant predictors in Algebra. In Geometry class controlling skill (Beta=0.19) with respect to temporary teachers, content surfing in total (Beta=0.13), all (Beta=0.16, 0.17, 0.40, 0.13, 0.22) except as temporary teachers in interest of online course, and content development with respect to total (Beta=0.52), male (Beta=0.13) and having qualification up to bachelor (Beta=0.52) are significant predictors. Similarly, content development with respect to total (Beta=0.19), master and above qualification (Beta=0.22), and temporary teacher (Beta=0.26), interest in online course with respect to total (Beta=0.15),

male (Beta=0.17), up to bachelor qualification (Beta=0.52), and permanent teachers (Beta=0.20) are significant predictors to the Trigonometry. Furthermore, internet surfing with respect to total (Beta=0.17), male (Beta=0.16), having master and above qualification (Beta=0.18), and temporary teachers (Beta=0.14), interest in online course with respect to up to bachelor qualification (Beta=0.34), class controlling skills with respect to total (Beta=0.12), male (Beta=0.12), and having master and above qualification (Beta=0.14), and content development with respect to total (Beta=0.17), male (Beta=0.20), and permanent teacher (Beta=0.30) and significant predictors to the Statistics. However, all significant predictors have positive contribution to the dependent variables indicating that if these types of problems in teaching mathematics online increased, the problems of teaching mathematical content also increase in some constant. In Table 2, the variables having significant effect on at least one case are reported and the case in which all results were insignificant were excluded.

Table 2: Regression weight of the problems of mathematics teacher in teaching mathematics online to teaching mathematical content (n=258)

Content	Problems	Total	Male	Up to bachelor	Master & above	Permanent	Temporary
		Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
Arithmetic	Interest in online course	0.15*	0.16*	0.26*	0.13*	0.12*	0.14
Arithmetic	Content development	0.14*	0.14*	0.04	0.14*	0.18*	0.04
Algebra	Content surfing	-0.08	-0.06	0.57*	-0.13	-0.07	-0.07
Algebra	Content development	0.13	0.16*	-0.19	0.15	0.06	0.15
Geometry	Class controlling skill	0.06	0.07	0.07	0.05	-0.04	0.19*
Geometry	Content surfing	0.16*	0.14	0.05	0.15	0.13	0.22
Geometry	Interest in online course	0.16*	0.17*	0.42*	0.13*	0.2*	0.06
Geometry	Content development	0.19*	0.19*	0.56*	0.14	0.14	0.23
Trigonometry	Content development	0.19*	0.21	-0.04	0.22*	0.12	0.26*
Trigonometry	Interest in online course	0.14*	0.16*	0.49*	0.10	0.16*	0.07
Statistics	Internet surfing	0.14*	0.13*	0.01	0.15*	0.13	0.15*
Statistics	Interest in online course	0.02	0.04	0.30*	-0.01	-0.01	0.03
Statistics	Class controlling skill	0.10*	0.10*	-0.05	0.11*	0.13	0.07
Statistics	Content development	0.16*	0.19*	0.31	0.13	0.30*	0.01

*p≤0.05

4. Discussion

The aim of the research was to find the effect of problems of mathematics teacher in teaching mathematics online to their problems in teaching mathematical content with respect to gender, qualification and types of job. Interest of teachers in online course found to be significant predictor in teaching Arithmetic; hence motivation of teacher is need to be improving for teaching Arithmetic effectively. However, beta value with respect to the teachers having up to bachelor qualification is high hence such awareness and motivation are needed more to them because the level of problems in using digital resources in mathematics teaching (Adhikari et al., 2022; Khanal, Joshi, Adhikari, Khadka, et al., 2022) and problems of mathematics teachers to teach mathematical content (Khanal, Joshi, Adhikari, & Khanal, 2022) are also high in Nepali context. Similarly, the problems of content development found to be significant factor to male teacher, those having master and above qualification and permanent teacher however comparatively high with respect to permanent teacher hence

government should have policy for enhancing the digital content development related skills of such all teachers. Similarly, content surfing and development are significant predictors to the Algebra hence additional training on developing such skills are needed to the teachers of secondary level teacher for teaching Algebra online effectively. The results of the survey conducted by Mubasher Hassan et al. (2020) indicate that teachers are facing technical difficulties in using online platforms for delivery of instruction as well as in creating e-content due to their lack of computer skills required for online teaching as well as creating digitalized material for teaching.

In instructing Geometry online, class controlling skill, content surfing, interest of online course, and content development are significant predictors hence concern stakeholder should focus on enhancing such additional skills of mathematics teacher. A survey conducted by Drijvers et al. (2016) also indicates that teachers' technological-pedagogical knowledge had a significantly positive effect on student achievements in both algebra and geometry in traditional face-to-face classes. Availability of digital resources, digital skills and training are the factors associated with the problems of Nepalese mathematics teachers in teaching mathematics online (Khanal et al., 2022). Similarly, content development and interest in online course are determinants of Trigonometry instruction, hence concern teacher should promote their such skills by watching tutorials, self-practice of subject supported digital tools, use of digital tool related user guides, and participating related online course, workshops, seminars, and conferences. Additionally, internet surfing, interest in online course, class controlling skills, and content development were found to be significant predictors to the problems of teaching Statistics online, hence concern stakeholders should develop certain training package enhancing such skills of teachers in future and management of appropriate resources for effective mathematics teaching and learning (Khanal, Panthi et al., 2021). Information and communication technologies are at the core of the teaching and learning mathematics (Al-Hilli, 2019).

In overall results shows that problems of class controlling and internet surfing are main issue for teaching Statistics, problem of teacher in interest of online course and content development found to be main issue of teaching Arithmetic, Geometry, and Trigonometry. This result is align with the finding of the study by Khanal et al. (2022) depicts that Algebra, Statistics, Vectors, Geometry, and Analysis are problematic contents for teachers teaching mathematics online. This may be due to the lack of training program and investment on digital resources. The investment in digital resources, awareness and training programs for mathematics teachers are not sufficient in the context of Nepal (Joshi, 2019) because the ICT competency (Joshi, Chitrakar, Belbase, et al., 2021; Joshi & Rawal, 2021) and digital pedagogical skills (Joshi, Khanal, & Adhikari, 2023) of mathematics teachers need to be improved in Nepal. Hence, internet surfing, interest towards online course, digital content development are major issues in instructing mathematical content online. In the present situation almost, countries have practice of online and blended learning, STEM education and developing digital citizenship however, mathematics and other subject teachers of Nepal are still not friendly with novel digital resources hence policymakers, education related organization and other international communities working in the field should have plan, program, and strategies for enhancing such skills of teachers of developing countries like Nepal. The concern stakeholders should plan and implement some digital awareness programs for teachers for proper use of digital resources for better teaching mathematical contents (Khanal et al., 2021).

5. Conclusion

Finding of this research indicates that the problems of skills of internet surfing, class controlling, interest towards online course, and digital content development are major issues in instructing mathematical content online. Hence, concern stakeholders should focus on settling these issues. The results of this research may be applicable to developing countries context and those having practice of online instruction in mathematics. Findings of this research will be applicable in developing training package, curriculum development of education related courses of universities, and to determine the priorities of financial and technical investment in the field of instructional support however the study is limited to mathematics teachers of secondary schools in Nepal hence further study may need among teachers of diverse subjects and level. Moreover, the study is limited to online survey; hence further study is also needed in applying other research designs. Additionally, the participants of this research may from urban areas i.e., having access of internet digital resources, and participation of online survey hence further study is needed in remote area of the Nation.

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