

Teaching Mathematics Through Online at the University Level: An Ethnographic Inquiry

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Abstract

Teaching mathematics at the university level expects a more complex form of algorithmic and theoretical exploration which sometimes could not be delivered as enough as the curriculum demands. In this context, this study primarily focused on exploring the opportunities and challenges of online classes while teaching-learning mathematics at the university level. It is an ethnographic study in which three students and a teacher who had a long experience in online teaching-learning practices were taken as the key respondents. The key informants were requested for writing the reflection about their experiences of learning mathematics through online mode. And, the responses of the students were analyzed and presented in different themes. Based on the responses of the key respondent students, poor networking, unavoidable disturbance, teacher's artificial pretending, negligence of the teachers, and less ICT-friendly curriculum & teachers were found as the major challenges for the online class. From the perspective of teachers' preparing documents for teaching, students' negligence, ICT being used only as a means of sharing, taking more time to complete the course, less interactive class, and evaluating the students were found as the major challenges. However, online education provided the teachers and student both with a friend in crisis, sitting home reaching school, reducing unnecessary expenditures, and utilizing video records of the classes. Similarly, for teachers; providing opportunities for professional development, web browsing, any time anywhere teaching-learning, and developing the skills for designing different online evaluation tools have been observed as the major opportunities. Based on these conclusions, even having many challenges of using ICT in teaching university mathematics, its appropriate use leads for the deeper and wider understanding of mathematical contents.

Keywords: Challenges, Connectivism, Ethnographic, ICT, Inquiry, Online Class, Opportunities

Background of the Study

Corona Virus Disease of 2019 (COVID-19), for the first time, was seen in the December of 2019 in Wuhan, China. Then, immediately in January 2020, World Health Organization (WHO) declared it as a pandemic and strongly recommended to

all the people of the world for stopping any kind of gathering activities. Among many other sectors, the educational sector is also affected seriously throughout the world. All most all the academic institutions got closed physically. In those contexts, most of the universities of Nepal also started their academic activities through online mode. Meanwhile, Tribhuvan University also decided to run its academic activities online by sharing an official document for conducting online classes called 'Online Class Conducting Directories, 2077'. Considering the context, the case campus also started all of its academic activities through online mode on July of 2020. It is obvious that being a campus in a rural area, the students also come from geographically different and difficult areas with the aim of getting higher education. And, it is also obvious that the rural area with complex geographical territory has many limitations (such as electricity, network connections, access to mobile, and so on) for getting regular participation in online classes for the students as well as for the teachers (Liguori & Winkler, 2020). With these all sorts of limitations, the participation of students in the case campus was exciting. Even if the participation of the students in the class was exciting, the nature of students sometimes creates difficulties in the teaching-learning process. On the other hand, in teaching mathematics, there is a huge role of symbols, big formulas, symbolic definitions, and many more, which is also a challenge for dealing with the content digitally (Laong & Alexandar, 2014). In this context, the present study is mostly oriented to explore the challenges and opportunities of teaching-learning mathematics at a higher level through online mode from the perspective of students and teachers.

Statement of the Problem

Teaching mathematics in online was write difficult to accept to the teachers and students before the pandemic. But, because of the long closing of academic institutions physically, most of the institutions in Nepal are forced to conduct their academic program through online mode even without having enough preparation. And, it is obvious to face many problems in case of lacking enough plans and readiness. The first problem that makes teaching online challenging is the lack of access to ITC tools like smartphones, and laptops among students as well as among teachers in some cases. Similarly, the next problem is of electricity and internet access which result in the barrier to the successful implementation of the academic program through online in the context of Nepal. Further, being a student and teacher of mathematics, I think mathematics is a more practical type of subject, Moreover, university mathematics demands many activities like drawing pictures, dealing with symbols, formulas, etc. which seems less ICT friendly. But of course, every new practice brings new possibilities so teaching mathematics in online made also opens up a new mode of thinking in teaching-learning mathematics. In this regard, exploring the possibilities and challenges of teaching-learning mathematics online from the students' and teachers' viewpoints was the main concern of the study.

In particular the study focused the answer of the following questions:

- What were challenges do the students and teachers been facing while learning mathematics online.
- How do the students and teachers have been experiencing learning mathematics online as an opportunity.

Review of Literature

The proper use of technology facilitates, strengthens, and speeds up the performance of educational institutions and provides better opportunities for conceptual understanding of the contents to the students (Maldonado, Garcia, & Sampedro-Requena, 2019). Integrating appropriate technological innovations in educational practices improves students' motivation, independence, participation, and attitude toward educational content and develops the ownership of learning among students (Khine, Ali, & Afar, 2017). Teaching online obviously demands and encourages the teachers and students to be aware on various technological innovations so that they could use them appropriately in the teaching-learning process. According to Newby et al. (2006) because of the ongoing pandemic situation of COVID, online distance learning has become a globally-preferred option. Teaching mathematics online seems more challenging than teaching other subjects because of its abstract nature, algorithms, symbols, and structures etc. (Mayer, 2009; Trenholm et al., 2016; Watson, 2010).

Online classes make learning meaningful at the university level by helping students for getting easy access to information sources (Bender, 2012). Furthermore, students can get opportunities for cross-validating their understanding using different sources of evidence. Also, the teachers may utilize the same opportunities for strengthening their concepts and ideas (Kokemuller & Media, 2014). A study conducted by a group of researchers (Zhu et. al., 2022) in the topic 'effect of online teaching at the university level' among 6000 college students concluded with various significant findings including online classes cultivate students' self-learning capacity, motivate to be an independent learner, helps to reach the authentic sources of information and so on.

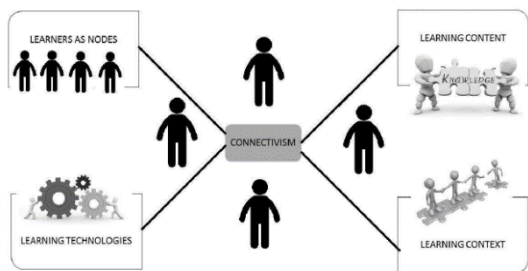
On the other hand, the major complication of online classes is the lack of face-to-face physical communication (Daalhuizen & Schoormans, 2018) which caused a lacking of understanding of students' problems personally to the teachers and at the same time, students do not get opportunities to engage with different activities and these all lead for lacking the expected outcomes of the academic program. Also, a study conducted by Yunag, Hang, and Ying (2016) explored students in online classes, even if they want to listen to their teachers but did not have the patience for listening which results in poor understanding. Another study conducted by Sukie (2019) identified that students are easily motivated to copy and paste for completing their assignments if they are more familiar with online sources. According to Zhu et. al. (2022), online

classes were found more effective at the higher level as compared to the lower-level students as the mature students themselves are motivated to learn and love to connect their understanding with various information sources. The study conducted by the team of Rawashdeh et al. (2021) with the objectives of exploring the advantages and disadvantages of the e-learning program in university education found that most of the sampled students shared e-learning programs provides scientific materials for learning and it helps for increasing the possibility of maintaining frequent contact among the students and as well as with the teachers. On the other hand, the same study found that most of the students explore maximum use of e-sites to keep the people in the isolation from societal activities and lack face-to-face interactions.

In the context of Nepal, the Faculty of Education (FOE) has been conducting its academic programs in both modes online and physical including mathematics education. In this regard, how the students perceive the practice of online mathematics teaching-learning reflects the degree of success of enrolling students in mathematics education at a higher level through online in the coming days.

Theoretical referents: Connectivism

The theory of connectivism focuses on connecting pupils with information sources (Simmon, 2004). With the rapid growth in the digital information communication system, there has been a major turn in the ways of generating and communicating knowledge through internet networks in a large community in a very short period of time. Primarily, connectivism believes that knowledge is generated and disseminated across networks of connections (Downs, 2013). The theory of connectivism perceives technology as the major component in the learning process and believes that meaningful learning would possible only through the collaboration of many information sources. ‘I store my knowledge in the mind of my friends is the most important idea of connectivism.



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The theory of connectivism believes that technology is the major component of the learning process. Sommon (2004) further shares that learning is the process of connecting the people of the learning community. This theory guided me in understanding the context and conditions of using information communication-related tools and technologies among the community of students, teachers and society.

Methodology

This study has been conducted within the framework of the multi-paradigmatic research paradigm (interpretive and critical) as the study aims at exploring the subjective understanding of the students and teachers regarding their experiences of learning mathematics through an ethnographic mode of inquiry valuing subjective understanding and multiple realities. As the key informants of the study, three students studying mathematics education at Bachelor's degree are selected purposively for multiple rounds of reflection writing. And, a teacher and I who have been teaching the selected students for the last couple of years are considered the key informants. The Thomas (2006) general inductive method was used to analyze the text of the study.

Results and Discussion

This section is divided into two different parts so as to respond the research questions separately.

Challenges of Learning Mathematics Through Online

While depicting the challenges of learning mathematics online, it is divided into two sections as from the perspective of students and from the perspective of teachers both of which are described with the following subheading:

From the Perspective of the Students

Based on the responses obtained from the participants, the following challenges have been identified and discussed :

Poor networking

As expected, most of my key respondents expressed that they are experiencing very poor internet network conditions. In most cases, students are joining their online classes through the internet networks of Nepal Telecom and Ncell. As Gorkha is being a hilly district, students get enrolled in online classes from various complex geographical territories so it is obvious to have a problem of poor networking. One of my key respondents (R1) shared his experiences in following way:

I have taken online classes from my hometown. There was the facility of Wifi so I joined my class using the data pack of Nepal telecom. The data networks did not work well all the time. It used to be affected directly by the minor push of wind and rain. Sometimes, the screen of the device stopped unexpectedly.

The experience of my key respondent (R1) explores the situation of poor access of students in internet network mostly among the students of complex geographical territories. The finding of the study conducted by Oroma, Wanga, & Fredi (2012) concluded with a similar kind of conclusion as most of the students felt difficulties in joining the online class because of poor bandwidth problems. As my theoretical referent suggested by Simmon (2004) focuses on connecting pupils with wireless connections

only possible with good network capacity, however in developing countries like Nepal, have been facing the challenges of bad networking for the successful implementation of online classes (OCED, 2020).

Unavoidable disturbance

Most of the students are belong to poor and lower-middle-class agricultural families. They need to go home for helping their parents during the main season of harvesting and planting the crops. Further, most of the students' parents get engaged in agricultural tasks almost all day. And, it seems uneasy for staying at home for the students when their parents get engaged in the field/ farm. So, this situation creates an un-adjustable situation for the students, and feel disturbed in learning. One of my key respondents shared his experience like this:

As I joined the online classes from my house, most of the time I need to go for household work so it was not so easy for joining the class regularly.

DelBoka (2020) has explored that in most low-economic and low-educated family context, children do get enough support from their parents for their online classes as the parents always want their children's support for their household work even during the time of their children's classes.

Teachers' artificial pretending

Among various challenges of online classes, the teachers' artificial pretending for keeping them absent in class by saying fake problems like internet problems, electricity problems, and physical illnesses in some cases has created a big challenge for effective implementations of the online programs. In this regard, one of my key respondents shared his experiences saying;

In some cases, teachers were found artificially pretending for teaching in case of laziness, lacking the content knowledge. Sometimes, teachers were found online in social media though they canceled their classes saying the problem of the internet.

Rosalina (2020) explored one of the common challenges of online classes as teachers will create/find many false options to avoid regular classes.

Planned Lateness/ Negligence of the Teachers

Even though it is obvious to have some delays in joining the class on some particular days for the teachers due to various unavoidable situations however some students shared their experiences saying teachers knowingly make delays in joining their class regularly.

Some teachers used to join their class frequently 10 minutes late and spend few minutes preparing the class so that they did not provide enough time for the class.

In some cases, teachers found regularly late in joining their classes which causes for not to complete the course in time and creates negative attitudes of the students toward the online class (Shearer et al., 2020).

Less ICT-friendly core mathematics curriculum and teachers

Mathematics deals more with various symbols, formulas, pictures, and different abstract concepts. Teaching and learning mathematics online create problems in showing such symbols and pictures on the screen which takes more time in teaching. In this regard, one of the sampled students shared his experiences;

The teachers do not find it easy to show the derivations or calculations by typing on the computer screen. It takes a long time to solve even a single problem in online teaching.

Serma et al. (2020) have also explored that most of the teachers in rural areas of developing countries do not have enough ideas for using ICT tools in their teaching and further, the course content is also not been designed for online structure so implementing online mode even if the courses are designed for physical classes is a major challenge (Zalat et al., 2021).

Only active students get more benefits from the online classes

The study found that the online class is found more meaningful to some leading students only. Such particular students get engaged and involved actively in the learning process. And even the teachers focus only on those students in the process of teaching. And also, teachers take decisions for moving forward in the class just by asking such leading students. One sampled student shared his experience as:

Some teachers are found asking questions to only a single student frequently in the class. And, they move ahead only with the discussion with that particular student by ignoring other students in the class. Even, they feel uneasy to run the course in case of their absence.

In online classes, very few students come in front always for discussing with teachers and with their peer which result that the low participation of low-performing and shy students further (Yunag, Hang, and Ying, 2016).

From the Perspective of Teachers

Based on the experiences of my key respondent teacher and myself the following challenges of online classes have been noted :

Preparing documents for teaching

As a mathematics teacher, it has always been a hard job for typing mathematical content into the computer because of its abstract nature, symbols, formula etc. I have been facing the bitter experience of spending a whole day even preparing a document for a single class of around one hour. Inserting different symbols every time in the documents makes me exhausted and leads me for taking a break from the work many times. As I experienced, my key informants share that '*Digitalizing the subject matter is more challenging for me, inserting symbols, charts, pictures etc. in the slides takes more time.*' Supporting this view of my respondent, Panthi and Belbase (2017) shared that lack of digital resources for mathematical instructions creates a challenge for the teacher to prepare the teaching documents.

Students' negligence

The most common problem as well as a challenge for a teacher is to create active participation of the students in online classes. In many cases, students just join their classes for attendance and move away from the classes. If the teachers ask them to open the video or ask some questions in case of doubting, they create/blame for the problems of the internet or something like that.

My respondent shared, '*students are with the electronic devices connected to the internet for the class however they are encouraged all the time for moving to different social networking like Facebook, tutor, TikTok etc. at the time classes going on*' which is also a major challenge of the online classes. Bali and Lui (2018) have explored that students in online classes are found very less active, even in some cases, they just join their class to show their presence in the class and move away from the class. In online classes, teachers may not request their students for sharing their videos because of various private reasons of students which caused students' negligence in their classes (Neuwirth, Jovic, & Mukherji, 2020).

ICT is being used only as a means of communication

As a teacher, while discussing and sharing experiences with other colleagues, it is shameful to know that we have been understanding the concept of using ICT only as a means of communication rather than an overall package for conceptual understanding. Most teachers are behind in understanding that ICT is more than only a tool to communicate, it also seems as another challenge for effective online classes. Piyani et al. (2020) have conducted a study in the south Asian context, to explore how teachers have been using ICT tools in their teaching, and the study concluded that most of the teachers have been perceiving that using ICT tools in their teaching just as a means of sharing their documents digitally.

Take more time to complete the course

As I discussed in the earlier sections, it is not so easy to communicate mathematical content through the screen of computers. It takes a long time even to complete a simple problem on the screen. My respondent explored that '*also solving problems on the screen creates different technical problems that directly demand a long time to complete the course*'. So, it has been another big challenge for the teacher to complete the courses within the given time bound. In our context, the curriculums are not designed for online classes so obviously, it takes more time to go through the online modes (Toquero, 2020).

Less interactive activities

In most of the online classes, it is very hard to bring all the students into the mainstream of learning as students are in different contexts, moods, and situations in their own

locations which caused a less interactive class. Also, it is very hard to design activities for an online class that motivates teachers only for delivering the speech one way which makes the class less interactive. My key respondent shared, *'the low-performing and shy-natured students do not get ready for sharing their confusion' which results in making them further weaker.* Babaali and Gonzalez (2015) have explored that the students in online classes are found very less interactive if they are joined from their homes. A similar kind of finding was obtained by Lunsford and Pendergrass (2016) in their study exploring the effectiveness of online classes. However, a study conducted by Leong and Alexander (2014) has claimed that low and average-achieving students in mathematics found more positive regarding online classes compared to the high achieving students.

Assessing Students Progress

As far as I experienced online classes as a Mathematics teacher of a higher level, evaluating students is more challenging. It is very hard to design the evaluating tools or the test items for online evaluation. Also, as students and teachers have not been enough familiarized with the digital ways of evaluating students' progress, even if we run the classes online, we should come back to the physical mode of evaluations. Though we are just learning about how students could be evaluated in online, there are many challenges in maintaining reliability and validity as well as originality in the students writing or to avoiding plagiarized activities among students (Sukie, 2019). In support to this view, my respondent shared, *'I have found most of the students used to submit the same file as the assignment in some cases'* which means students misuse digital resources in their writing, they search on different websites for their tasks and perform copy and paste and forward to their teacher. He further added, *'students do not encourage for engaging themselves as a learner to the problems rather they directly move to the internet and motivated directly to copy'*. In support of this view, Parajuli (2016) shared that one of the major challenges of online classes is to minimize the plagiarized activities of the students.

Opportunities of Teaching-learning Mathematics through Online

While exploring the opportunities of teaching-learning mathematics online, like as challenges in the earlier sections, the students **From the Perspective of Students**

The opportunities are explored with the following themes:

Half a loaf is better than no bread

We have a well-known proverb 'half a loaf is better than no bread' (नहुनु मामा भन्दा कानै मामा जाती). In the time of crisis, almost all the sectors were completely closed however the academic sectors were almost doing their regular activities online. Even though it was less effective comparatively than physical classes, at least the basic right to education was experienced at the time of crisis. One of my key respondents shared her

experiences as

Though there are enough lacking, online education benefits in many ways. It cannot be neglected role of online classes for students of remote areas even in the pandemic situation.

In this regard, the online mode of teaching-learning becomes the friend of crisis for keeping our students up-to-date with their learning. Piryani et al. (2020) shared that online classes shifted the paradigm of teaching and learning. The online class helps to keep the education system movable even in time of crisis.

Sitting home reaching college

Students got opportunities to join their classes from their own location, motivating them in their learning. They got a chance to utilize their time for sharing their experiences with their friends, seniors, and teachers regularly which helps to reduce the pain of the pandemic as well. In this regard, one of my key respondents shared; *The online classes provided a good opportunity to read from own house. It uses to remove the unnecessary burden of walking twenty-five minutes in the early morning.* The online class allows them to carry even their colleges in their hand using their smartphones and laptops. This strengthens the principle of online learning ‘anytime, anywhere, anybody’ (Leire, 2016).

Knowing about information technology: Open up the new way of sharing

One of the most significant opportunities provided by online classes is forcing students and teachers to learn and use ICT tools in the learning process. Online classes open up many possibilities and ways of running formal classes virtually. It is found that online classes help significantly to raise digital literacy among the students as well as to the teachers. In support of this view, one of my key respondents shared; *The online class helps to be aware about using ICT tools which was a new experience not provided by the face-to-face class.* In this context, online classes help and encourage students and teachers for strengthening their exposure to the appropriate use of ICT tools as the study conducted by Heckman et al. (2014). The online classes help students to solve a problem independently which helps students to be independent learners raising their thinking ability with the help of ICT tools (Dumford & Miller, 2018).

Reduces unnecessary expenditures

It is interesting to know that online classes help to reduce the expenditures of students. Most of the students used to join their online classes from their homes so that it helps to minimize heavily their everyday expenditures for food and other. Also, it is also found exciting that some of the students have gone home by leaving their rental room at district headquarters which helps in reducing the burden of unnecessary expenditures. In a study conducted by Songkram (2015), has suggested that online classes are very effective for students from an economic point of view for the students in most

developing countries if students need to go far from their homes for continuing their studies. Students can get opportunities for continuing their studies from their own home location sitting with their family obviously reduces the unnecessary economic burden to their parents as well (Aparicio, 2016).

Utilizing the recording of the class

Most of the sampled students shared their experience of utilizing the recorded videos of the class frequently for many times to further strengthen their understanding. Also, the recorded videos of the class found most significant in case of the students absent in the class. Some of the students shared that they have listened to the record of the classes frequently even in their household work like cooking, farm working etc. Gautam and Tiwari (2016) have explored that interactive recorded videos could be utilized many times for understanding the content taught in the online class by the students.

Opportunities from the Perspective of the Teachers

The following opportunities have been explored based on the responses of my key respondents from the in-depth interview and from my own experiences as a teacher;

Develop the command in dealing with the content of mathematics digitally

As a teacher, having a long experience of teaching online, found myself better in dealing with the content of mathematics digitally than in the beginning days. I found myself improved in preparing the mathematical documents for online classes. Online classes forced me to get familiarized the digital forms of different mathematical symbols, formulas etc. which helps for developing the command in sharing mathematical content digitally. In adding to these statements, Mr. Gentleman shared his experiences, '*Online classes encourage me for searching different ways of making easier for solving different problems of mathematics finally led forcefully for acquiring basic skills in using different mathematical software like Latex, Mathematica, GeoGebra, SPSS etc.*' It further explores the skills in showing the content through different pictures, graphs, videos etc. which helps for the professional development of the teachers. Online classes force teachers for developing their skills in using different software in their teaching and for administrative purpose as well (Liguori & Winkler, 2020).

Provide opportunities to get participation in various training programs, conferences, seminars and discussions

Among many other opportunities of online classes, it brings a kind of flood in organizing different training programs, conferences, seminars, discussions, sharing programs etc., and these all obviously lead teachers to their professional growth. While taking to this point, thanks to the online class, I remembered that I participated in around four different training programs, presented papers in three different conferences, and participated

in more than five seminars and discussion programs in the last one and half years. Organizing such programs online really minimized the cost (almost no cost), it is time-friendly, location friendly, and also audience friendly which all leads for organizing more programs and encouraged a high number of participants. In support to the views of Paudel (2020), Mr. Gentleman have explored that, '*COVID-19 has brought a kind of flood for raising the digital awareness among the teachers and students*' that encourage teachers and many other officials for organizing many supporting gatherings (like; training, sharing, webinar, seminar etc.) related to the organizations.

Provide opportunities for web browsing immediatly at the time of confusion

As a teacher of a higher level, many confusing situations come during the discussion in the class however in most of the cases such problems have been solved immediately through web searching which is only possible in the case of online classes. And, also, I have experienced the benefits of sharing various visual documents uploaded on the internet on the online classes that could best describe the content, which could only be possible in online classes. My respondent further shared, '*the online class helps and encourages teachers and students for validating their knowledge/ understanding through various knowledge sources.*' This helps teachers for further strengthen their ideas and skills in their areas (Keller, 2014). Also at the same time, students get opportunities to make their understanding deeper with the help of various online resources (Dorke, 2018).

Time and location friendly: Anytime, anywhere, and anybody

One of the best benefits of online classes as experienced by teacher is that it is time and location friendly. I remembered many classes I have taken at my friends' and relatives' homes, and I am sure that the same opportunities are also been utilized by my students as well. Also, supporting my experiences my respondent shared, '*the online classes have provided opportunities for utilizing the comfortable time for taking classes in case of unavoidable situations for the regular classes.*' I have also utilized this opportunity many times in case of disturbance in the regular class for me and also for my students. This is why taking online classes seems more time-friendly and location-friendly (Hasan, 2006).

Conclusion

From the findings I come to the conclusion that teaching mathematics online has created both the opportunities and challenges. Though it is being challenging for the administrator, teachers and students to run academic activities via online means, it creates many opportunities as well at the same time. I would prefer to say as a researcher and teacher, the opportunities provided by the online class keeps its challenges in shadow, means the benefits of online classes encourages us for accepting the challenges

and motivated gradually to minimize the challenges for further strengthening the opportunities of online class. There are many points to think seriously for the effective implementation of online classes in higher level. Some problems could be resolved with the minor effort of the teachers and administration which need to be solved immediately and at the same time the institution further needs to request for other governmental and non-governmental organizations to manage the resources to minimize the challenges we and our students have been facing during online classes. Also, the institution needs to make a clear short-term and long-term plan to prepare the faculties, staffs and students for implementing online classes successfully.

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