Emerging ICT Tools, Techniques and Methodologies for Online Collaborative Teaching and Learning Mathematics

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Abstract

Emerging ICT tools, techniques and methodologies (TTM), which might be helpful for pedagogical practices, for a synchronous and asynchronous mode of teaching and learning mathematics in online and distance mode of education. This action research reported from the underpinning practices of the authors as trainers, course facilitators, educational researchers and innovative practitioner-the possible uses of emerging ICT tools, techniques and methodologies for teaching and learning mathematics. This article highlights some key strengths with possible integration of emerging ICT tools, techniques and methodologies to facilitate online and offline task(s) and assessment(s) of the learners, and trainees in a collaborative manner. Epistemologically, our experiences reflected that the learning experiences of the learners and trainees would be better by incorporating emerging ICT tools, techniques and methodologies in day to day practices in online classes specifically more in this present context. We have concluded the paper by highlighting the effectiveness of use of emerging ICT tools, techniques and methodologies as a new innovative virtual teaching and learning platform.

Keywords: ICT Tools, Pedagogical, Methodologies, Underpinning practices, Moodle, Collaborative tools.

Introduction

In the present context, Information, Communication and Technology (ICT) has become a part of personal and professional life. No doubt, people have been using ICT tools for various purposes. New innovation and development in the COVID-19 period are changing the way in which mathematics contents are delivered. The COVID-19 has adversely been impacting the education sector throughout the world. However, COVID-19 has created possibilities of virtual learning environment and opportunities of gaining experiences for individual and collaborative learning for students, teachers, and trainers. In this line, integration of ICTs tools, techniques and methodologies (TTM) in this situation is required. These requirements give rise for integrating of ICT tools for meaningful teaching and learning. Likewise, maximum mathematics teachers either in rural or urban, might get the chance to be participated in various online workshops, and webinars. Those workshops and webinars might be helpful for supporting teaching and learning mathematics. Even, mathematics teachers have got chance to challenge their existing modes of instruction by enabling personalized learning (Mohd & Shahbodin, 2015). Personalized learning shall help the mathematics teachers to develop their ways of learning at their own pace and time to be prepared for excelling virtual teaching/learning system.

This ongoing pandemic situation offers mathematics teachers to be aware of the recent paradigm of teaching and learning mathematics by participating various online workshops and webinars. These workshops webinars helped them to use TTM as a pedagogy for teaching and learning mathematics. Further, they were also engaged in online platform to learn about how to assign and evaluate individual and collaborative tasks (Dahal & Pangeni, 2019). Likewise, commonly used synchronous tools such as ZOOM, Google Meet, Facebook Messenger, Teams, Skype, and Skype for Business (Zhang et al., 2016) ; asynchronous tools; Moodle, Chamilo, Canvas, Easy Class, Blackboard, Google classroom, GeoGebra classroom and Desmos and the activity ICT tools, namely, google form, google quiz, and menti meter were being popular during the workshops and webinars. It is seen that teachers, teacher educators and researcher were being aware of the various other ICT tools, techniques and methodologies. But, how to integrate ICT tools, techniques and methodologies effectively in teaching and learning mathematics have not got the room for discussions (Ghavifekr & Rosdy, 2015). In addition, there were several unanswered questions such as; in what ways do instructors and students use ICT tools? How does the present changing scenario assist the course facilitators' progress as well as practitioners to develop new perspectives about the use of ICT tools, techniques and methodologies? How does an online workshop and webinar expose the levels and types of student engagement over there? What do these opportunities and challenges suggest for pedagogical changes in their institution(s)?

In contrast, ICT tools must not be limited for illustrating the concepts as cognitive tools, not only to support visualization but also provide(s) mental modeling by utilizing educational technologies as enablers of pedagogical ideas (Ge et al., 2015). At this stage, maximum mathematics instructors (but not limited to mathematics) even in Nepal were worried by questioning themselves such as, how ICT tools, techniques and methodologies were being used? What types of activity need to assign to the learners most of the time? Which activity is easy for instructors to use? How to engage the learners in the online classes? [start up, middle and end], how to review the learners' tasks? What were the best practices of using ICT tools? These are some of the questions on how to engage the learners and trainees during the class and/or training by adopting pedagogical values congruent with technology-enhanced active engagement for meaningful pedagogical purposes in mathematics as well as in other subjects (Milner-Bolotin, 2015).

However, this is the era of a paradigm shift in relation to effective uses of ICT tools in teaching and learning by raising the self-question- how should the teacher and/or teacher educators implement technology-enhanced learning? No doubt, for that teacher educators must be updated with the latest ICT tools, techniques and methodologies for effective teaching and learning mathematics. With the revolution in ICT tools, techniques and methodologies, the world is transforming into a global village. Digital learning platforms and embodied tools in the platform are a normal part of education in the world. So as the case in the developing countries like Nepal, web-based delivery of the courses is not new. The course facilitators have been using various collaborative tools for course delivery and assessments (Bower & Wittmann, 2009). Some of the collaborative tools are forum discussion, workshop, chat, comment box and Wiki (to name but few) in Moodle and docs, slides, sheets and Jamboard in Google apps. Likewise, collaborative learning scenarios in online courses from school to universities and classroom to training sessions are rapidly increasing for online and distance mode of teaching and learning mathematics. This could be because of various reasons such as facilitators were busy in academic work-such as lesson planning, and seeking the ICT tools for the activity (to name but few), the maximum number of courses offers by schools and/or university and/or a large number of learners in the online classes and/or sessions.

In this scenario, Kathmandu University School of Education (KUSOED), an institution that takes the leading edge in Nepal with the slogan of "Transforming Education and Society"--incorporating technological tools in pedagogical practices. Until this study was designed and implemented, rarely, collaborative tools were used to assist teaching to decrease the time for evaluating a large number of learners' task(s). We wondered, which of the collaborative tools (forum discussion, workshop, chat, comment and Wiki (to name but few)in Moodle and docs, slides, sheets and Jamboard (to name but few)in Google apps), can best facilitate the task(s) and assessment(s) of the learners? Are available collaborative tools not well designed to facilitate the task(s) and assessments? In particular, how the collaborative task decreases the time of the facilitator(s) for manual evaluation in mathematics?

In this ethos, collaborative teaching scenarios aim to assist teaching to facilitate the task(s) and assessment(s) of the learners. We have selected the collaborative tools forum discussion, workshop, chat, comment box, and Wiki in Moodle and docs, slides, sheets, and Jamboard in Google apps to address the gap and need of collaborative tools in the present context. These tools intend to help facilitator(s) to design and to evaluate collaborative task(s). The study intends to explore the design process of the collaborative learning scenarios scripted by the facilitator(s) in Moodle and Google apps. Due to this improvement, the learning experiences can be better by designing multiple collaborative tasks by using various collaborative tools in school to higher education classroom and/or training in mathematics teaching and learning.

Likewise, collaborative learning is being widely used in the academic field and has many advantages such as not need to allocate additional time for evaluation, fair, and instant feedback and evaluation. So far, collaborative learning is appropriate when the objective is that the students learn in group work. In this context, we have considered that a collaborative learning scenario comprises three interconnected entities, in the Moodle platform, namely, users, learning system, and collaborative tasks but google apps, it is an individual basis. While in the Moodle, the user entity included learners and facilitators, the learning systems which support the collaborative learning tasks and the collaborative learning tasks performed by learners and facilitators.

Hence, the learning systems are frequently used to support the learning tasks designed by the facilitators and completed by the learners. In this scenario, the Learning Management Systems (LMS) are possible powerful systems employed during the e-learning processes (Dahal & Pangeni, 2019). The facilitators use LMS to create and evaluate the overall impression of the courses, and the learners use it to perform the learning tasks, to submit content, and to communicate with their classmates and the facilitators. Moodle (Modular Object-Oriented Developmental Learning Environment) is one of the more popular and extensively used open-source LMS and the same is the case of google apps, namely, docs, slides, sheets, and Jamboard for a collaborative task(s). Collaborative tools help and support to manage learning tasks without replacing the facilitators. In addition, the facilitators at Kathmandu University School of Education have been using such tools and the services of the Moodle system and google apps to support face-to-face and online & distance mode of teaching and learning mathematics (but limited to mathematics only). However, this system presents several boundaries specifically to support collaborative learning tasks between learners (Despotovi-Zraki et al., 2012).

The paper is structured as follows. We present the review of related collaborative tools used in Moodle and Google apps. Section 2 is a review of related work. Section 3 explains the method. In section 4, we explore the findings and lessons learned. Finally, the paper ends with some conclusions and future research issues.

Collaborative Tools in Moodle

The collaborative tools such as forum discussion, workshop, chat, comment box, and wiki that were embodied in Moodle of all the latest versions. In the following section, each of the tools were reviewed.

Forum Discussion

The forum discussion is a collaborative activity tool where learners and facilitators can exchange ideas by posting comments. Normally, there are four basic forum types. Forum posts can be graded either by the facilitators or other learners or both. Hence, a forum can contribute significantly to successful communication and community building in an online environment. Even, we can use forums for many innovative purposes in educational settings.

Workshop

It is a self and peer assessment activity with many options. Learners can submit their work via an online test tool and/or attachment(s). There are two grades for a learner, one is for submission and another is for their task. Even more, learners can access their work and their peer assessments of other learners' work.

Chat

This is another collaborative learning tool. The chat activity on the module allows learners to have a real-time synchronous discussion in a Moodle course with course facilitators and a team of learners.

This is a beneficial way to get a different thoughtful of each other and the topic being deliberated – the mode of using a chat room is quite different from the asynchronous forums. The chat room contains several features for managing and reviewing chat discussions.

Comment Box

This is also a collaborative tool in Moodle, which helps the learners to post their insight, difficulties, and problems. The facilitators will reply to the learners concerns by clicking reply button.

Wiki

A wiki is an assemble of collaboratively authored web documents. Basically, a wiki page is a web page everyone in the class can create together, right in the browser. A wiki starts with one front page. Each learner can add other pages to the wiki by simply creating a link to a page that doesn't exist yet. The following snapshot will help to understand it better.

LA1: Planning Document This is a collaborative planning document (Wiki) where you will be combined ideas of GIS at the very first day of the course. Feel free to add, edit (where appropriate) and delete contributions. But bear in mind everyone's actions are recorded.

Textbox 1: Wiki Question

Multiple attempts by learners in the figure 1 underneath.

How do you define GIS?			
Diff	Version	User	Modification

Figure 1: Wiki Responses History

Hence, wikis can be a powerful tool for collaborative work. The entire group of learners can edit a document together, creating a session product, or each student can have their own wiki and work on it with the facilitator and classmates.

Collaborative Tools in Google

This section reviews the collaborative tools docs, slides, sheet, and jamborad (to name but few) that were embodied in Google apps.

Docs, Slides, Sheet, and Jamborad

Real-time collaboration for collaborative tasks — create, edit, and share documents online and access them, and track changes across all types. Also, it makes it easy for the entire group of the learners, edit a document together, creating a session product, or each student can have their own and work on it with the facilitator and classmates in real-time.

Supporting Literature: Collaborative Tools in Moodle and Google as LMS

LMS has been used as a powerful platform to support teaching-learning processes in the academic context for 21st-century learners. As mentioned in the introduction, the Moodle system is one of the more important and widely used free LMS. In the literature, it can be found a bundle of issues related to the LMS, and specifically with the Moodle system. These issues have emerged from the use of Moodle to improve face-to-face courses or online and distance learning (Martín-Blas & Serrano-

Fernández, 2009). In this regard, some researchers have been exploring how students' evaluations supported by Moodle can facilitate the preparation of assignments, the auto evaluation, and contribute to the formative e-assessment in LMS courses (Rodríguez-del-Pino et al., 2012).

Further, additional research studies have been concentrating on the emergence of the commercial LMS and their progress to open-source systems. These studies qualitatively emphasize and explore collaborative evaluations in Moodle. Although, Moodle has been used is multiple educational institutions in Nepal. On the other side Google apps has been used in various educational institutions. Both the apps offer the learners and facilitators to learn and develop collaborative tasks with some limitations. For instance, this system is not yet a full collaborative learning system (Dillenbourg et al., 2001). In this ethos, Moodle and Google apps are developed due to instructional designers, developers, and researchers. It has been improving the system through the expansion of services that allow adding new functionalities to the system. (Mazza & Milani, 2004) for educational propose.

Method

This action research was carried out in the context of the researchers' teaching and learning practices as trainers, course facilitators, educational researchers and innovative practitioners(McNiff, 2013; Dahal & Pangeni, 2019) based on courses offered by Kathmandu University School of Education for the first, third and fourth semester of MEd in Mathematics Education, followed by its online internship program. In the meantime, the authors had organized various workshops and webinars (February 2020 to July 2020). Further, its usefulness was observed throughout the semester and training periods. Likewise, the study completed the action research cycle demonstrated in the different phases (I, II, III and IV) as a cycle. In first Phase, the study was focused to identify the existing possibilities of the use of collaborative tools for integrating emerging ICT tools, techniques and methodologies. This leads to determine the types of intervention needed. In Phase II, we oriented the students and trainees by using collaborative tools. Finally, in phase III and IV, we analyzed the data.

Findings and Lesson Learnt

The theme wise findings of each phase of the action research cycle are presented, as follows:

Learning Opportunities in use of Collaborative Tools. It was very pleasing to know about students' and trainees' experiences on collaborative activities. Each of them has their conceptualization on assigned tasks since it was an appealing task for them. As outlined, we conducted surveys and interviews, we got provoking ideas of the learners while assessing peer-work concerning with given guidelines. Moreover, none of the learners disagreed that peer-reviewed of the collaborative tasks was worthwhile as a learning activity. Learners perceived that peer review of the collaborative task(s) was a better option for them to correct and to be corrected on their own. Similarly, some of the students and trainees agreed that such collaborative activity helped them to develop the culture of sharing ideas by replying and/or providing feedback for their peers.

Challenges of Collaborative Tools. For the first time, collaborative activities were interesting as well as challenging (Dahal & Dahal, 2015). Collaborative activities were really facilitating. However, it was very difficult to justify their reasoning strategies in relation to given guidelines for submission and evaluation. According to learners and trainees, grading peers were tuff for some of them because they think their peers may complain about the marks they receive in collaborative activity (Kennedy, 2005). On the other hand, for a single assignment, learners were compelled to put double effort. In most of the traditional assignments they do and simply submit to the facilitator(s) but in this process, it is mandatory to review at least one or more peers' work. It demands to be knowledgeable on all guidelines to review or evaluate peer's work (Echeverria, 2011).

Lesson Learnt from Students. Right after—facilitator(s) setup collaborative activity with guidelines for submission and rubric for peer-evaluation. The role of learners and trainees were to submit the assigned task and evaluated peer's work. In this process, the learners tried to evaluate being strict on guidelines. Further, comments and feedback were also significant in this particular case. Nevertheless, some of them did not care about guidelines and/or rubric of evaluation. They simply awarded a full grade and comments and feedback also was not as expected by the facilitator(s). In the process of analyzing scores, comments, and feedback, the students did not care about guidelines and/or rubric for peer-evaluation (Machado & Tao, 2007). Thus, major attention was to given in this kind of activity would be fairness in marking, commenting, and providing feedback (Dahal, 2013) by one learner to others.

Context, Construction, and Reflection of Collaborative Tools. With the different phases in collaborative activities of the collaborative tools in Moodle and Google apps, in the first phase, facilitators need to set up-once all components of each of the options are carefully set up. In the submission phase, learners will submit their assigned tasks by the time learners might get the chance to review their peers' work as per the given instructions and/or rubric for evaluation. Finally, the facilitator(s) approved the final grades of the evaluation with concluding remarks to complete this phase. During the activity phases—students and trainees were engaged in reviewing, grading, commenting, and providing feedback to their peers. Thus, there are many important tools in collaborative tools that support both students and facilitator(s) in the teaching and learning process. Finally, this tool might be helpful to change the learning culture (Dahal & Pangeni, 2019) in mathematics in school to university by facilitating learning as a part of the assessment.

Lesson Learned as Facilitators. The facilitator(s) has a greater role in designing, creating, and implementing collaborative activities. For that facilitators-need additional time while designing activity conceptually and technologically. The collaborative activity is set with all necessary components such as instruction and evaluation--the role of facilitator(s) might be finished (Martin et al., 2008). Nevertheless, a manual review of the collaborative activity might require thoroughly taken care. Obviously, this activity reduces the facilitator workload of keeping grade records, grades, comments, and feedback. Hence, a basket of the manual workload of the course facilitator(s) might be minimized in implementing such activities.

Conclusions

The major objective was to establish the practice of collaborative tools to assist teaching to facilitate the task(s) and assessment(s) of the learners. This article has highlighted possible uses of the Moodle collaborative activity tools and Google apps with the help of collaborative tools in teaching and learning. For the implementation of collaborative tools during teaching, we created instructional collaborative tools such as forum discussion, workshop, chat, comment box, google docs, slides, sheets, and Jamboard and Wiki. A major insight is that it is functional, creating no problems, easy to implement, help facilitators to reduce their workload, empowers learners in learning by reading and evaluating peers' work. Although this research was short-termed, these tools would support the design and evaluation of collaborative learning scenarios that were integrated into the Moodle and Google apps. The study indicates towards the establishment and usages of Moodle and Google apps integrated with collaborative tools to make teaching and learning mathematics more effective.

Note: This paper is based on the research work done by the first author. The second author is the supervisor of the first author. The third author encouraged me to conduct the research by offering me some possibilities and relevance of the issue. The fourth and fifth authors are the "critical friend" of the researcher who offered critical suggestions.

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