



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



# Flipped classroom: How higher education institutions (HEIs) of Bangladesh could move forward during COVID-19 pandemic

Md. Shahadat Hossain Khan<sup>a,\*</sup>, Benadjih Oiriddine Abdou<sup>b</sup>

<sup>a</sup> Department of Technical and Vocational Education (TVE), Islamic University of Technology (IUT), Room: 304, Academic Building 1, Board Bazar, Gazipur, 1704, Bangladesh

<sup>b</sup> Department of Technical and Vocational Education (TVE), Islamic University of Technology (IUT), Room: 301, Academic Building 1, Board Bazar, Gazipur, 1704, Bangladesh

## ARTICLE INFO

### Keywords:

COVID-19  
Flipped classroom  
Online learning space  
Higher education  
Pandemic

## ABSTRACT

Due to COVID-19 pandemic, Bangladesh along with most of the developing countries is facing unexpected impediments towards functioning their regular activities. Most importantly, schools at all levels and Higher Educational Institutions (HEIs) have been completely shut down since March 26, 2020 that directly obliged stakeholders (Ministry of Education, institutes authorities, parents and other relevant bodies) to adopt online education. Due to having very less experience, in many cases no experience at all, of conducting teaching and learning wholly online by HEIs of Bangladesh, myriad challenges have been encountered by teachers and students. In order to find out a viable technique for dealing with these challenges, this paper addresses two research questions: What are the available open Source technologies that could be used as an alternative of paid LMS system for any developing countries during this COVID-19 pandemic? and Is exiting flipped classroom technique suitable for continuing teaching and learning during COVID-19 pandemic? In an effort to solve the above mentioned questions, a case study method was adopted. The findings of this study propose a pathway (framework) through which the HEIs of developing countries will be able to continue teaching and learning without investing money and organizing training during this COVID-19 pandemic and similar other emergency situations. This strategy provides a simple but reliable emergency means which is based on flipped classroom theory. The HEIs of Bangladesh particularly, and other developing countries generally will be benefited from this proposed framework while they do not have established means to carry their teaching and learning. This paper lastly addresses a few limitations of this framework and provides guidelines to the policymakers on how to incorporate it into the HEIs during this emergency context.

## 1. Introduction

Since December 2019, a mysterious disease emerged in the Chinese's city of Wuhan, the capital of Hubei, a province located in the central part of the country (Lu, Stratton, & Tang, 2020). This disease would later be known as coronavirus disease 19 or simply as COVID-19 (Source: WHO, 11 February 2020). During the early stage of the virus, which is believed to have originated in a wet-market, the Government of China (GOC) played down its severity and compared it to ordinary flu (Jandrić, 2020). However, as of late January 2020, it became obvious that this was a novel virus, far more severe than it was first thought, as it started spreading rapidly within China and beyond its borders (Peters et al., 2020). By the time this article is being written, it has been reported that

more than 5,710,393 people around the world have been infected (John Hopkins University & Medicine, May 28, 2020).

In an attempt to hamper the outbreak of the virus, the GOC swiftly adopted various drastic measures including a total lockdown of the city of Wuhan toward the end of January 2020 (Fanelli & Piazza, 2020). Despite their best efforts, however, the virus quickly got out of control and spread to almost everywhere in the world (Fanelli & Piazza, 2020; Gao, Tian, & Yang, 2020). Between February and April 2020, many developed countries such as the USA, the UK, Italy, France and Spain became the epicenter of the pandemic. The number of daily registered new cases and deaths grew significantly fast that the total number of infections and deceases in those countries is now higher than that of China, where the outbreak started (John Hopkins University &

\* Corresponding author.

E-mail addresses: [skha8285@iut-dhaka.edu](mailto:skha8285@iut-dhaka.edu) (Md.S.H. Khan), [benadjih@iut-dhaka.edu](mailto:benadjih@iut-dhaka.edu) (B.O. Abdou).

<https://doi.org/10.1016/j.ssaho.2021.100187>

Received 28 May 2020; Received in revised form 14 January 2021; Accepted 2 July 2021

Available online 6 July 2021

2590-2911/© 2021 The Authors.

Published by Elsevier Ltd.

This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Medicine, May 28, 2020). Furthermore, countries such as India, Brazil, Turkey, and other developing nations seemed to have been fairing well at the initial stages of the pandemic. However, that has changed in recent weeks as the number of infections has hiked significantly leading to their respective governments to initiate total lockdown (Al Jazeera, March 23, 2020).

Bangladesh, as a developing country, has not been exempted from such a recent rapid spread. Since late March 2020, the whole country has been in a total lockdown as the government attempts to contain the virus (The Daily Star, April 09, 2020). As a result, most of the daily activities have been put on hold with schools at all levels and HEIs being at the forefront. With the number of new infected cases increasing exponentially over the last few weeks, more than 40,321 as of May 28, 2020 according to the data released daily by the Institute of Epidemiology, Disease Control and Research (IEDCR) (<https://www.iedcr.gov.bd>), Prime Minister Sheikh Hasina announced that the educational institutions may not open until September 2020 due to this COVID-19 pandemic (The Daily Star, April 28, 2020).

At this stage, the HEIs of Bangladesh are facing four immense challenges from three different stakeholders. *Firstly*, government through the Ministry of Education (MOE) and the University Grants Commission (UGC) of Bangladesh were reluctant to approve online education as an alternative during the coronavirus lockdown. However, with the pandemic still not under control and lockdown being extended successively, government has therefore encouraged the HEIs to adopt the online strategy as a means of conducting their teaching in order to facilitate the students' progress and avoid academic session jam (The Daily Star, April 30, 2020). *Secondly*, in the case of private universities particularly, the situation is even more alarming, when all expenses starting from staff and faculty salaries to the payment of other necessary bills along with important purchases, depend entirely on the various tuition fees paid by the enrolled students. If the lockdown is to extend for a longer period of time as indicating the Government of Bangladesh (GoB), it could lead to some serious repercussions on the survival of such institutions, let alone their wellbeing. Therefore, the need for teaching and learning to continue is of extreme importance to these institutions, not only to secure their own survival, but also to ensure the enrolled students do not end up losing their time and money. *Thirdly*, given that the spreading of coronavirus pandemic in Bangladesh seems to be on a high and as of yet there is neither confirmed clinical treatment for the illness nor preventive vaccination globally, this leaves the country in particular, and the whole world at large, with no option other than adopting online education as the only available alternative to keep education running in this critical situation (Bourne, Harris, & Mayadas, 2005; Harasim, 2000; Tabner, 2020). Otherwise, the entire education system of the countries that fail to adopt it will remain shut down until the situation gets back under control (Tabner, 2020). *Lastly*, parents and guardians are concerned of the wellbeing of their children along with the successful completion of academic year 2019–2020. The above mentioned challenges along with various others, have led to the suggestion from the MOE, UGC and other educators and educational administrators in HEIs to conduct the teaching and learning online until the time when the situation gets back to normal.

Consequently, in response to this emergency, the HEIs have already decided to shift the teaching and learning to the online environment (online education) like has been the case in various parts of the world including China where Peters et al. (2020) claimed that almost every course offered by the various universities has been made accessible online. However, in case of Bangladesh, like many other developing countries, the prospect of introducing online learning in the various levels of education has regularly been discussed by their various stakeholders. Nevertheless, the practical implementation of such programs has so far been unsuccessful to materialize for various reasons (Khan, Hasan, & Clement, 2012). This leaves universities, polytechnics and other institutions of higher education with great challenges on how they can swiftly deal with this unprecedented situation. Besides, since online

teaching and learning is, in most cases, new to some students and teachers, all concerned are not convinced with prospect of online education in Bangladesh. It is reported that some teachers are also not optimistic about it especially when it comes to courses that involved much practice (Huq, 2020). Daniel (2020), nonetheless, rightfully argues that, through online education, it is pretty much possible to teach students who require practical training (like Engineering students) but admits that special arrangements must be considered for it to be successful.

In order to find out a remedial technique for addressing the challenges of online teaching and learning, the authors designed an integrated strategy which was carried out during this pandemic situation at a HEI of Bangladesh. This strategy may provide a simple but reliable emergency means through which teaching and learning can be delivered at any HEIs of developing countries during lockdown situation.

## 2. Purpose of the study

The objective of this article is to suggest a pathway by which the HEIs Bangladesh particularly and other developing countries with similar contexts generally may be able to continue teaching mostly their theoretical subjects during this COVID-19 pandemic and similar other emergency situations. In this paper, a modified method of a Flipped Classroom technique is presented which may enable teachers to continue their instruction during this lockdown situation. This is in line with a recent research that suggests that teaching and learning can take place without having both teacher and students at face-to-face (physical presence) classrooms (Daniel, 2020). In order to address this purpose, the following two research questions were listed for guiding the article:

- (i) What are the available open source (free) technologies that could be used as an alternative of paid LMS system for any developing countries during this COVID-19 pandemic?
- (ii) Is exiting flipped classroom technique suitable for continuing teaching and learning during COVID-19 pandemic?

## 3. Theoretical underpinning

### 3.1. What is flipped classroom?

Over the last few years, flipped classroom has been gaining significant attention and admiration due to its flexibility and increased access to high speed internet connectivity and digital resources as well as technology (Milman, 2012; Mok, 2014; Sun, Xie, & Anderman, 2018; Zhai, Gu, Liu, Liang, & Tsai, 2017). A number of studies were conducted as a result leading to the succession of various definitions. Flipped classroom is a “pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter” (Flipped Learning Network (FLN), 2014).

In addition to that, DeLozier and Rhodes (2016) and Long, Cummins, and Waugh (2016) briefly explained that flipped classroom is the practice whereby learning materials, which are usually taught in class in conventional methods in the form of lectures, are assigned to students to study outside the classroom and class time is used for a variety of other learning activities regarding the assigned learning materials. O'Flaherty and Phillips (2015) extended the later definition by adding that more emphasis should be put on students' gaining basic understanding of the concept before coming to class and applying it during class time. That led Cheng, Ritzhaupt, and Antonenko (2018) to summarize the definition of flipped classroom as simply “an instructional approach that reverses the traditional teaching method” (p.794). Therefore, the strategy encourages teachers to share the learning materials with the students, in the form of Word document, PowerPoint presentation or video, etc.

before the actual time for class is reached. This allows students to read the lesson and try to understand it, mostly on their own, prior to the class time and offers teachers the opportunity, during class time, to ensure that every student actively participates in the explanation of the lesson and deep understanding is acquired.

### 3.2. Why flipped classroom is important for higher educational institutions

The constant evolution of technology during the last few decades has had a major impact on almost every sector in the world. The HEIs are obliged to find new ways of educating their students in such a manner that they will be able to fit in the job market and make necessary adjustment whenever needed (O'Flaherty & Phillips, 2015). One of the many suggestions offered to tackle this issue was to change the method of teaching from the tried and tested traditional approach to a new paradigm where more emphasis will be put on the students' ability to understand concepts deeply and independently (Khan, 2015).

Indeed shifting the education trend from teacher-centered, where teacher prepares himself and comes to class to deliver the instructions while students attentively listen, to the student-centered approach where students actively participate and become the central figure during classes was met a mixed feeling from the teachers' perspective, to say the least (Froyd & Simpson, 2008; Khan & Markauskaite, 2017). Faculty members claim that this strategy takes so much time given the content that is to be covered by the end of the term. In order to provide solution to such claims, Herreid and Schiller (2013) suggested the following: "Wait! Help is on the way in the form of "the flipped classroom" p. 62. By giving students learning materials before class time, the teacher is able to focus more on the level of understanding of the students during class time along with the practical aspect of the subject matter. Moreover, students will be able to engaged in their learning which promote student-centered teaching (Law, Hafiz, Kwong, & Wong, 2020).

### 3.3. Limitation of using flipped classroom

Although flipped classroom has generated so much excitement among educators, worldwide, literature reveals that a number of drawbacks come along the way. One of the biggest limitations of this approach is the fact that students may sometimes intentionally decide not to take the necessary preparations before class time. In this regard, Ozdamli and Asiksoy (2016) expressed concern that "Students may be stubborn at the beginning and may come to class without preparation" p.103. Should that prove to be the case, the success of the flipped classroom will be in jeopardy. Additionally, it was revealed that some students have complained of not being able to grasp some the concepts properly on their own before class time (Tanner & Scott, 2015), thus making it difficult for them to be active in class and completing their practical assignment as required by the methodology.

Additionally, literature has also revealed time as another major constraint of the flipped classroom method (Keengwe, 2014). Recording videos that can be easily understood by students will require additional time that fa-to-face classroom may not Lastly, it is also reported that students have some reservation on the compatibility of the method in some courses or subject. Keengwe (2014) reports that some students found the approach more useful in science such as biology and mathematics while at the same time they don't find it as effective in the English subject.

The literature, on the other hand, provides guidelines on how to improve these limitations. For instance, Class materials, learning materials (Slides, Videos, etc) need to be carefully designed and presented to the students so that students will find them understandable (Ozdamli & Asiksoy, 2016). This method, in this way, places more responsibilities on teachers to make sure that students will receive from them can easily be understood (LaFee, 2013). Teachers professional development is another important area to concentrate on for the successful integration

of the flipped classroom approach. Surprisingly, this is one of the least mentioned limitation in literature according to O'Flaherty and Phillips (2015). Proper training is needed by teachers so as to enable them knowing how to use the various software available for video recordings among other aspects. All these limitations prove that more research needs to be conducted in this domain in order to make it an efficient approach for delivering instructions during ordinary times but more especially during COVID-19 pandemic and beyond.

### 3.4. Working principle of flipped classroom

According to O'Flaherty and Phillips (2015), the aims of teachers who adopt the flipped classroom model are to substitute the passive learning state of students to an active learning state and generate more time and opportunities for students to practice their newly acquired knowledge. Therefore, there are two learning spaces (components) in the flipped classroom, first component: individual learning spaces (on-line) and second component: interactive learning spaces which is usually in a face-to-face setting. This is in line with a study of Long et al. (2016) in which they argued that "A flipped classroom course can be taught in various physical facilities, not only a traditional lecture hall, but also in technology-enhanced classrooms, studios, laboratories, computer labs, meeting rooms, outdoor settings, or in online learning spaces" (p. 181). In order to combine these two *pedagogical* techniques, flipped classroom professional development series of the University of Hong Kong (HKU) suggested few steps (Source: HKU, February 2, 2018), which could be briefly presented here as follows:

*General working principle:* The main working strategy of flipped classroom is organizing two activities one after the other (Fig. 1).

*First activity:* teachers should share (upload) *lecture materials* to the students before organizing face-to-face class. Students will go through the lecture materials to understand the contents. During this time, students should identify their difficulties (content/topic that may not be clear to them) which could be asked to the teachers during face-to-face class.

*Second Activity:* during face-to-face class, teachers make themselves available to receive questions from students. Students' confusion (this misunderstanding may arise during first stage that is in individual learning) will be clarified at the face-to-face teaching. The teacher will receive students' questions until all students understood the lecture.

#### 3.4.1. Online learning space

*Aim:* the aim of organizing an online platform is to provide learning spaces to students to achieve better learning outcomes via flipped classroom.

*Brief working strategy:* Initially, the flipped classroom technique needs

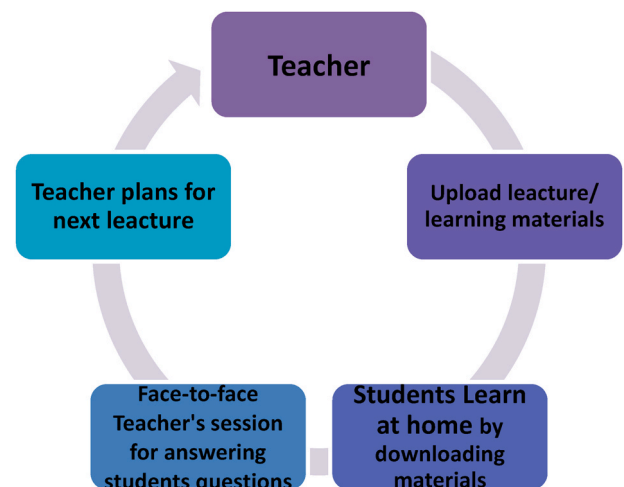


Fig. 1. Flipped classroom activities.

an online platform, the HKU suggested Moodle or Open edX for online platform. Many other online tools are available that have many positive benefits towards facilitating students activities (Khan, Shamim, & Nambobi, 2018, pp. 147–162). By using online platform, different student-centered activities could be arranged. This platform facilitates teachers uploading their class lectures, and other required learning materials that should be prepared by the teachers following the course contents (curriculum). Moreover, in order to ensure collaborative learning, discussion forum will be organized to assist students and teachers to share their knowledge.

### 3.4.2. Face-to-face learning space

**Aim:** the aim of including face-to-face classes is to clarify the issues (topics) which students may not understand on their own individual learning and apply the acquired knowledge (online space).

**Brief working:** Teachers will organize regular classes on a face-to-face context with the intention of not conducting regular teaching (lecture presentation) but rather offering students the opportunity to ask questions and seek clarifications regarding the uploaded contents. Therefore, the teachers' main task is to clarify students' understanding by solving students' questions. This session is highly interactive between teachers and students to enhance students' understanding about the topic (lecture materials which teachers uploaded to the students at first stage). In the case of more practical subjects, the teacher assists students to correctly apply the new knowledge through various exercises and practical activities.

## 4. Method

This study was carried out in the context of a developing country context, that is, Bangladesh during the COVID-19 pandemic. At the beginning of this pandemic (late March 2020), when all educational institutions were in a total lockdown, this study was started with an aim of finding the solution of the stated research questions. A case study method was used for conducting this research. An experienced teacher (first author) who had prior experience on technology-enhanced teaching and learning research with an academic position of Co-ordinator of LMS system of his institute, conducted an online class as an experiment at the beginning of this lockdown. The intention (first author) was to suggest a guideline to his institute particularly and other HEIs generally, on 'how other teachers would conduct their classes via online with a minimal training (online), and with existing available resources'. Therefore, he identified a suitable pedagogical technique (Modified Flipped Classroom) and chose available technologies (Open source, (Hasan, Khan, & Clement, 2015)) that could be integrated with the pedagogy for teaching theoretical subjects during this lockdown without investing additional infrastructure (technology) and organizing additional teacher training. The findings based on his experience is articulated in the following sections.

## 5. Findings

Based on the result of the case study, the following findings were revealed. The findings of the study present in a sequential manner that provide the solution of the stated research questions:

### 5.1. Proposed flipped classroom technique

The HEIs of Bangladesh and other developing countries with similar contexts may consider the following modified flipped classroom technique for conducting their regular classes due to any emergency situation like COVID-19 pandemic. A brief discussion is provided, how a teacher could integrate this flipped classroom technique via online by altering face-to-face (physical interaction) classes.

### 5.2. First part: online learning space

For online space, developed countries typically use Blackboard <https://www.blackboard.com/en-apac> (commercial software), or Moodle <https://moodle.org/> (open Source software which requires a suitable infrastructure that needs some additional cost and manpower) platforms which involve costs. Moreover, it needs additional professional development training (both teachers and students) on how to integrate it in their teaching and learning. Therefore, during this lockdown condition, the HEIs may not be able to make these platforms available quickly enough. In this emergency context, the HEIs should prefer to adopt a platform which does not require additional cost and any training for teachers and students. Considering these challenges, this study proposes an integrated online platform which is free to use and does not require organizing any additional training. A teacher can use three different open Source tools for organizing the modified flipped classroom activities. The activities (pedagogical processes) are discussed with practical examples in the following figures. The first authors conducted a post-graduate course on educational psychology (TVE 6153) by using the proposed flipped classroom technique. For the sake of visual understanding for the readers, we included few related activities as screenshots.

**Aim:** The main aim of creating this Gmail group is to foster/support shared communication with students.

Activities via Gmail Group:

(i) Teachers may create a common Gmail Group that includes all students email address on it. (ii) Teachers could send any information (administrative or academic) to all students by sending one email. (iii) Students on the other hand may individually respond or communicate to the teachers after receiving email through the same channel (See Fig. 2).

**Aim:** The main aim of using Google Drive is for sharing teaching and learning materials to all students.

Activities via Google Drive: (i) Teachers upload class lectures (PPP), class notes, learning materials, videos for clarifying the ideas, and many other contents to students via Google drive two days prior to conducting actual online class; (ii) Teachers share these materials via Google drive by using group Gmail (account); (iii) All students will be able to access these materials and save these at their computer for their learning.

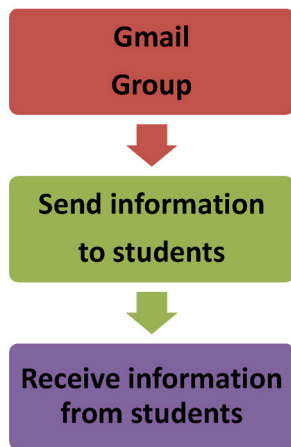
**Aim:** Creating a closed Facebook group for collaborative learning.

Activities via closed Facebook group: (i) Teachers create a closed Facebook group aiming of ensuring privacy, for instance, nobody other than teachers and students can access/read/see any contents (activities) of this group. (ii) Teachers may invite all students to join the group by sharing group link via group Gmail. (iii) By this group, teachers will be able to engage students in many activities, such as group discussion, discussion forum for clarifying any topics, question and answer sessions, collaborative learning etc.

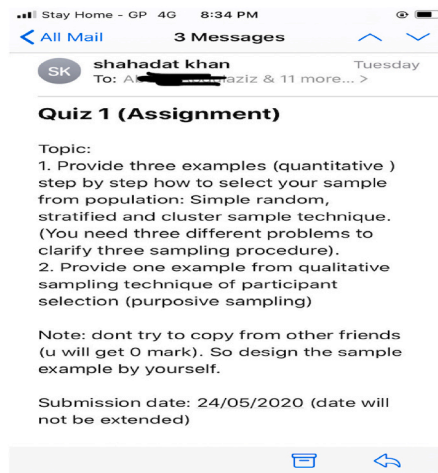
Advantage: Teachers do not need any training for implementing the above stated techniques (Figs. 3–5). During emergency times like this, it is recommended that teachers make use of any facility they are familiar with instead of trying to train them to use something they are not comfortable with (Daniel, 2020). Nevertheless, if anybody still does (need for training), then there are many YouTube tutorials which may facilitate that particular teacher in this lockdown. Additionally, since every member in the group can share their learning experiences, it can be a useful platform for collaborative learning. Furthermore, teachers will be able to post some questions to engage students into a discussion which leads to student-centered teaching.

### 5.3. Second part: online classes

The face-to-face classroom component of flipped classroom is shifted to online session due to lockdown (COVID-19). The aim of online classes is same as to face-to-face component of flipped classroom. For online classes, Zoom platform (<https://zoom.us/>) could be used free of cost and with few limitations.

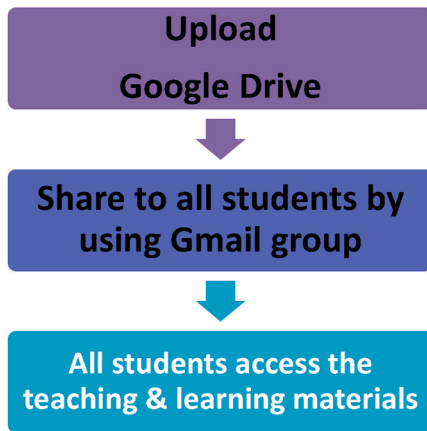


(a). Gmail Group for communicating all students

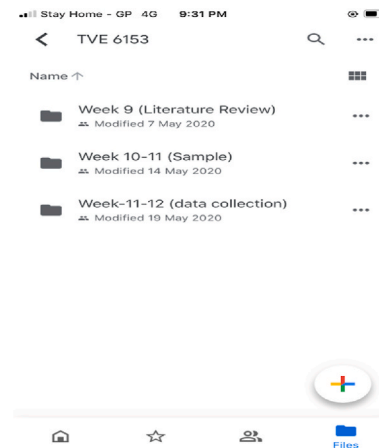


(b). Practical example of communication via Gmail group

Fig. 2. (a). Gmail Group for communicating all students  
(b). Practical example of communication via Gmail group.



(a). Google drive for sharing resources



(b). Practical example of sharing teaching and learning materials

Fig. 3. (a). Google drive for sharing resources  
(b). Practical example of sharing teaching and learning materials.

How it works: Before organizing online session, teachers must send the lecture materials to students a couple of days earlier. During those days, students read and try to understand the contents that teachers sent. In order to avoid misinterpretations by the students, teachers are recommended to send other supporting materials such as videos, audios, other learning resources, and complete guidelines so that students understand the lecture materials at home. Then teachers arrange online classes. During online sessions, students are invited to ask questions that will enlighten the lecture contents which were sent a few days before. This is how an online class could be conducted.

Aim: The main aim of using Zoom platform is for conducting online classes (substitute of the face-to-face component of flipped classroom due to Covid-19).

Activities via Zoom Classroom: (i) Teachers sign in Zoom platform for online classes; (ii) Teachers will invite all students to the Zoom classroom by using group Gmail from Zoom; (iii) Since students are aware of the online class time, within few seconds, students accepted invitation and join to the online session. Initially, teachers invite all students to ask questions (the questions should come from the lecture materials sent to students two days before), and thereafter, teachers clarify issues

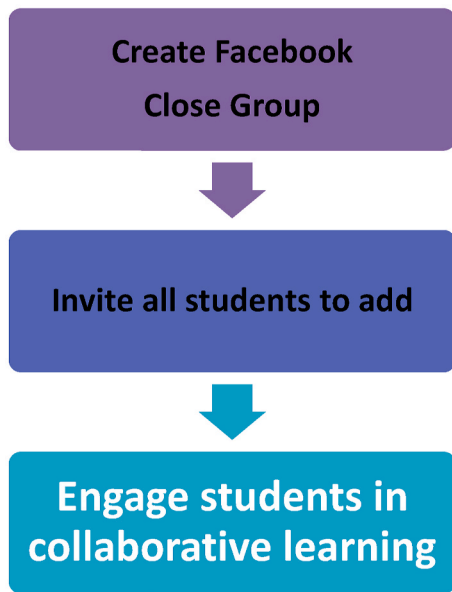
(questions) raised by the students. (iv) The session (class) is ended when there are no more questions. (v) Teachers may request students to provide few suggestions on how to improve next session. (vi) Lastly, teachers should provide information (instruction) to students on what will be sent for the next class.

Disadvantage of using Zoom: Open Source Zoom online platform has limitation of adding max. 100 participants and 40 mints duration in a session (maximum). Therefore, A class having more than 100 students will not be appropriate.

## 6. Discussion, limitation and recommendation

### 6.1. Discussion

This study shows how a faculty member, without having any formal training, could conduct online classes during any emergency contexts, like COVID 19 pandemic. The findings which were revealed from a case study, present not only different open Source learning platform (Gmail for communication, google drive for sharing teaching and learning materials, Zoom for conducting online session and/or Google classroom)

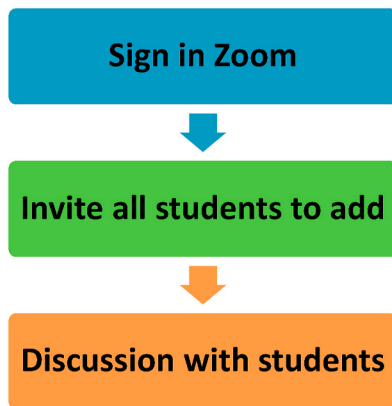


(a). Closed Facebook group for collaborative learning

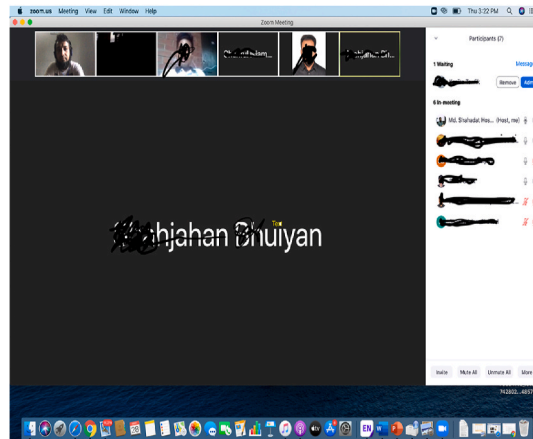


(b). Practical example of collaborative learning via closed Facebook group

Fig. 4. (a). Closed Facebook group for collaborative learning (b). Practical example of collaborative learning via closed Facebook group.



(a). Zoom online classroom



(b). Zoom online classroom (practical example)

Fig. 5. (a). Zoom online classroom (b). Zoom online classroom (practical example).

but also provide pedagogical technique (modified flipped classroom) for offering teaching and learning activates during COVID-19 pandemic. Thus, the above stated two research questions were addressed via the actual teaching and learning practices which were carried out by the case study. The main motivation of conducting this study was to provide immediate solution on 'how an educational institute could peruse their online classed when they do not have prior experience on conducting online classes'. This study successfully shows that a teacher will able to conduct his/her classes via online with the existing available resources.

6.2. Limitation of this model

The proposed flipped classroom is modified approach which teachers from HEIs of developing countries can conduct their classes during this COVID-19 pandemic situation. If any HEIs of developing countries have their own LMS system, then this proposed open Source platform may not

be useful. However, the proposed flipped classroom technique (pedagogical philosophy) could be integrated through their existing LMS. Besides, the following challenges should be considered by the HEIs before using this flipped classroom technique:

- Online class may not be equivalent to face-to-face class. We may introduce this flipped classroom technique due to COVID-19 pandemic situation;
- Someone may use Google Classroom (<https://classroom.google.com/h>) instead of Gmail, Google drive, and Facebook group. However, we chose these three open Source tools because they do not require additional training for teachers and students during lock-down situation. Practically, in our context (Bangladesh), it was not possible to organize training for introducing Google Classroom during this COVID-19 pandemic.

- Few theory subjects in engineering (or similar disciplines) may require extra care to make students understand. For example, teachers could make audio records by explaining difficult concepts of his lecture and these records also should be sent along with lecture. For this type of record, a teacher can use a tool name *Audacity* <https://www.audacityteam.org/download/>
- Teachers should bear in mind that, designing this flipped classroom technique needs time. Therefore, teachers may allocate time for planning, designing, constructing flipped classroom for students. If teachers could not invest time, then this technique will not be useful.
- Moreover, student's participation towards flipped classroom is another challenge. Therefore, an effective strategy needs to be introduced to motivate students towards flipped classroom.
- The findings of this study are contexts dependent. It can not be implemented in a context where institutional supported LMS already exists and online teaching and learning has been practiced before COVID-19. However, it provides useful knowledge for those HEIs who did not have exiting LMS system and did not practice online teaching and learning before COVID-19 pandemic.

## 7. Recommendations

In order to formulate policies, the HEIs of developing countries are encouraged to do the following: (i) The lab classes particularly in engineering disciplines (or similar disciplines) are not recommended in the modified flipped classroom technique; (ii) Both teachers and students need to be motivated towards using this technique. Therefore, authorities of HEIs should take necessary initiatives to motivate them in this regard. (iii) Regular assessments (Mid-term and Semester final examinations) are not encouraged to be conducted online. (iv) Finally, before arranging the face-to-face examination, the HEIs may provide, minimum, one-week time for face-to-face classrooms during which teachers may provide further explanations of what they taught online.

## 8. Conclusions and future research

Given the urgency of the situation and the fact that it is still unclear how long this COVID-19 enforced lockdown is going to last, the HEIs in Bangladesh, without or with no proper online teaching learning platforms, must find ways to keep their activities going until when normalcy returns. For that reason, therefore, this article suggests the modified flipped classroom as an alternative and viable solution for that matter. This suggestion is derived from previous studies that highlighted a various range of positive impact if flipped classroom is implemented correctly (Castedo et al., 2019; Cheng et al., 2018). Due to it numerous advantages, from students' liking it to instant support from instructor through active learning, flipped classroom is regarded as an ideal pedagogical model where both purely theoretical as well as practical based subjects can be taught successfully in the HEIs (Castedo et al., 2019; Long et al., 2016).

McNally et al. (2016) however, observed that, alongside the endorers of flipped classroom (students who enjoy this pedagogical model), there is another group of students who does not seem positive about it named "the resistors". That is one of the major challenges of this pedagogical approach. Finally, it is suggested that further studies need to be carried out in order to improve the level of acceptance from students as well as motivate them to get prepared as best as possible before class time. In relation to accumulate teachers' and students' experiences on this platform (modified flipped classroom) and to provide additional supports towards implementing this platform, future qualitative research (interview based) could be conducted. This proposed research may provide additional empirical evidence (internet connectivity and speed, problems encountered by teachers and students, and so on).

## Authorship contributions

On behalf of the authorship of this article, I am declaring that, Dr. Md. Shahadat Hossain Khan is the first author who was the lead of concept design, and conducted the case study. Mr. Benadjih Oiriddine Abdou is the second author who supported towards finalising the article. Moreover, he included the literature review and conceptual framework of this article under the supervision of the first author.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgements:

The authors wish to thank and Mr. Hamisi Ramadhan Mubarak and Mr. Maroine Nassoufouddine for their useful editorial support in relation to updating academic writing.

## References

- Al Jazeera. (March 23, 2020). *India locks down over 100 million people amid coronavirus fears*. Retrieved 19 May, 2020, from <http://www.aljazeera.com/news/2020/03/scores-indian-districts-lockdown-coronavirus-200323041150247.html>.
- Bourne, J., Harris, D., & Mayadas, F. (2005). *Online engineering education: Learning anywhere, anytime*. Journal of Engineering Education.
- Castedo, R., López, L. M., Chiquito, M., Navarro, J., Cabrera, J. D., & Ortega, M. F. (2019). Flipped classroom-comparative case study in engineering higher education. *Computer Applications in Engineering Education*, 27(1), 206–216. <https://doi.org/10.1002/cae.22069>.
- Cheng, L., Ritzhaupt, A. D., & Antonenko, P. (2018). Effects of the flipped classroom instructional strategy on students' learning outcomes: A meta-analysis. *Educational Technology Research & Development*, 67(4), 793–824. <https://doi.org/10.1007/s11423-018-9633-7>.
- Daniel, S. J. (2020). Education and the COVID-19 pandemic. *Prospects*, 1–6.
- DeLozier, S. J., & Rhodes, M. G. (2016). Flipped classrooms: A review of key ideas and recommendations for practice. *Educational Psychology Review*, 29(1), 141–151. <https://doi.org/10.1007/s10648-015-9356-9>.
- Fanelli, D., & Piazza, F. (2020). Analysis and forecast of COVID-19 spreading in China, Italy and France. *Chaos, Solitons & Fractals*, 134, 109761. <https://doi.org/10.1016/j.chaos.2020.109761>.
- Froyd, J., & Simpson, N. (2008). *Student-centered learning addressing faculty questions about student centered learning* (Paper presented at the Course, Curriculum, Labor, and Improvement Conference, Washington DC).
- Gao, J., Tian, Z., & Yang, X. (2020). Breakthrough: Chloroquine phosphate has shown apparent efficacy in treatment of COVID-19 associated pneumonia in clinical studies. *Biosci Trends*, 14(1), 72–73. <https://doi.org/10.5582/bst.2020.01047>.
- Harasim, L. (2000). *Shift\_happens\_Online\_education\_as\_a\_new.pdf*. *The Internet and Higher Education*, 3, 41–61.
- Hasan, M., Khan, M. S. H., & Clement, C. K. (2015). Emerging trends of using open source technology for sustainable teacher training programme in Bangladesh. *Procedia-Social and Behavioral Sciences*, 195, 862–871.
- Herreid, C. F., & Schiller, N. A. (2013). Case studies and the flipped classroom. *National Science Teachers Association*, 42(5), 62–66.
- Huq, S. (2020). *Will online higher education be the new normal in post-pandemic Bangladesh?*. Retrieved 25 May, 2020, from <https://opinion.bdnews24.com/2020/05/01/will-online-higher-education-be-the-new-normal-in-post-pandemic-bangladesh/>.
- Jandrić, P. (2020). Postdigital research in the time of covid-19. *Postdigital Science and Education*, 2(2), 233–238. <https://doi.org/10.1007/s42438-020-00113-8>.
- John Hopkins University & Medicine. (May 28, 2020). *COVID-19 dashboard by the center for systems science and engineering (CSSE)*. Retrieved 28 May, 2020, from <https://coronavirus.jhu.edu/map.html>.
- Khan, M. S. H. (2015). Emerging conceptions of ICT-enhanced teaching: Australian TAFE context. *Instructional Science*, 1–26. <https://doi.org/10.1007/s11251-015-9356-7>.
- Khan, M. S. H., Hasan, M., & Clement, C. K. (2012). Barriers to the introduction of ICT into education in developing countries: The example of Bangladesh. *International Journal of Instruction*, 5(2), 61–80.



- Khan, M. S. H., & Markauskaite, L. (2017). Approaches to ICT-enhanced teaching in technical and vocational education: A phenomenographic perspective. *Higher Education*, 73(5), 691–707. <https://doi.org/10.1007/s10734-016-9990-2>.
- Khan, M. S. H., Shamim, M. R. H., & Nambobi, M. (2018). Learning styles and online tools: How to construct an effective online learning environment *Optimizing student engagement in online learning environments*. In *IGI global*.
- Law, L., Hafiz, M., Kwong, T., & Wong, E. (2020). Enhancing SPOC-flipped classroom learning by using student-centred mobile learning tools. In S. Yu, M. Ally, & A. Tsinakos (Eds.), *Emerging technologies and pedagogies in the curriculum* (pp. 315–333). Springer.
- Learning Network, F., & Fln. (2014). *What is flipped learning?*. Retrieved 15 May, 2020, from [flippedlearning.org/wp-content/uploads/2016/07/FLIP\\_handout\\_FNL\\_Web.pdf](http://flippedlearning.org/wp-content/uploads/2016/07/FLIP_handout_FNL_Web.pdf).
- Long, T., Cummins, J., & Waugh, M. (2016). Use of the flipped classroom instructional model in higher education: Instructors' perspectives. *Journal of Computing in Higher Education*, 29(2), 179–200. <https://doi.org/10.1007/s12528-016-9119-8>.
- Lu, H., Stratton, C. W., & Tang, Y. W. (2020). Outbreak of pneumonia of unknown etiology in wuhan China: The mystery and the miracle. *Journal of Medical Virology*, 92(4), 401–402.
- McNally, B., Chipperfield, J., Dorsett, P., Del Fabbro, L., Frommolt, V., Goetz, S., & Rung, A. (2016). Flipped classroom experiences: Student preferences and flip strategy in a higher education context. *Higher Education*, 73(2), 281–298. <https://doi.org/10.1007/s10734-016-0014-z>.
- Milman, N. B. (2012). The flipped classroom strategy what is it and how can it best be used? *Distance Learning*, 9(3), 85–87.
- Mok, H. N. (2014). Teaching tip: The flipped classroom. *Journal of Information Systems Education*, 25(1).
- O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *The Internet and Higher Education*, 25, 85–95. <https://doi.org/10.1016/j.iheduc.2015.02.002>.
- Peters, M. A., Wang, H., Ogunniran, M. O., Huang, Y., Green, B., Chunga, J. O., ... Hayes, S. (2020). China's internationalized higher education during covid-19: Collective student autoethnography. *Postdigital Science and Education*. <https://doi.org/10.1007/s42438-020-00128-1>.
- Source. WHO. (11 February, 2020). Retrieved 20 May, 2020, from <http://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen>.
- Source, & Hku. Designing your own flipped classroom: Online and pre-class elements. Retrieved 15 May, 2020, from <https://tl.hku.hk/2018/02/designing-your-own-flipped-classroom-online-and-pre-class-elements/>. (Accessed 2 February 2018).
- Sun, Z., Xie, K., & Anderman, L. H. (2018). The role of self-regulated learning in students' success in flipped undergraduate math courses. *The Internet and Higher Education*, 36, 41–53. <https://doi.org/10.1016/j.iheduc.2017.09.003>.
- Tabner, I. T. (2020). *Five ways coronavirus lockdowns increase inequality* (p. 8). April: The Conversation.
- The Daily Star (April 09, 2020). Enforce total LOCKDOWN. Retrieved 17 May, 2020, from <http://www.thedailystar.net/frontpage/news/enforce-total-lockdown-1891186>.
- The Daily Star (April 28, 2020). Schools may stay closed till Sept. Retrieved 21 May, 2020, from <http://www.thedailystar.net/frontpage/news/schools-may-stay-closed-till-sept-1897510>.
- The Daily Star (April 30, 2020). Ensure online classes: ministry, UGC to all universities. Retrieved 25 May, 2020, from <http://www.thedailystar.net/online/news/ensure-online-classes-ministry-ugc-all-universities-1898335>.
- Zhai, X., Gu, J., Liu, H., Liang, J.-C., & Tsai, C.-C. (2017). An experiential learning perspective on students' satisfaction model in a flipped classroom context. *Journal of Educational Technology & Society*, 20(1), 198–210.