

Students' learning experiences in a flipped classroom: A case study in Ghana

Benjamin Aidoo
University of Iceland, Iceland

Johnson Tsyawo
Jasikan College of Education, Ghana

Francis Quansah
Fosu College of Education, Ghana
&
Sampson Kwadwo Boateng
University of Manitoba, Canada

ABSTRACT

The purpose of this research was to analyze students' experiences in the flipped classroom and examine their perceptions of learning outcomes. This study aimed to introduce the flipped classroom approach (FCA) to undergraduate students to elicit more practical and conceptual information on how teachers can use this approach. The study utilized a mixed case study research design with triangulation to collect data through a survey and focus groups. The results showed that most students had positive perceptions of the flipped classroom in terms of engagement, usefulness, effectiveness, expectation, and satisfaction and would recommend the course taught using the flipped classroom approach. Also, the flipped classroom had positive learning impacts such as achievement, motivation, critical thinking, and collaborative learning. However, students faced some challenges learning in the flipped classroom environment due to a lack of resources to support their learning. The research contributes to the limited existing literature on flipped classrooms for stakeholders in developing countries.

Keywords: *Collaboration; blended learning; engagement; flipped classroom; motivation; ICT*

INTRODUCTION

An instructional strategy that seems to improve students' engagement is the flipped classroom approach (FCA). A flipped classroom is a learning model that uses technology to deliver lessons outside regular class time to increase active student learning, collaboration, and engagement during the in-class time (Bergmann & Sams 2012). Tomas, Doyle, and Skamp (2019) define flipped classroom as a learning approach where traditional classroom lectures shifted outside regular class using technology and face-to-face class time for active learning activities. Brooks (2014) explained that the flipped classroom approach uses technology to provide students with active instructional and learning activities with videos and reserve class time for discussion opportunities and collaborative work. In the flipped classroom, students are engaged with learning materials, including videos and other materials outside of the classroom, to prepare for active learning activities in class (Nichols, Burgh & Kennedy 2017). The idea behind the flipped classroom is to

change the traditional lectures to introductory lessons where students are exposed to content materials in videos or online materials, reserving class time for discussions, peer interaction, active learning activities, and problem-solving activities (Velegol, Zappe & Mahoney 2015). O'Flaherty & Phillips (2015) noted that flipped classroom learning begins with engaging students with lower thinking activities at home and performing higher thinking activities in the classroom. These activities enable students to control their learning to perform independent tasks, enhancing their individualized learning (Huang & Hong 2016; Olakanmi 2017).

There is continuous advocacy for the flipped classroom approach due to its numerous characteristics reported in the literature. For example, students can collaborate among peers in a discussion guided to construct their knowledge (Brooks 2014; McLean, Attardi, Faden & Goldszmidt 2016). Students can be engaged in mastery level of learning during the in-class activities, which foster fundamental skills of remembering, understanding, and application at home, to build on more profound activities that enhance higher-order thinking skills (Bloom 1956). Freeing learning activities in the classroom creates space for instructors to use the instructional time for collaboration and knowledge application (Kim, Kim, Khera & Getman 2014).

In responding to the classroom learning disruptions and difficulties from COVID-19, teachers were asked to utilize teaching opportunities to support student learning. Researchers have noted that the flipped classroom approach provides opportunities for teachers to plan effective learning strategies that promote student learning and autonomy (Al-Samarraie & Hurmuzan 2018; Hew, Jia, Gonda & Bai 2020; Yunusa, Sanusi, Dada, Oyelere, Agbo, Obaido & Aruleba 2021). The flipped classroom approach could be an alternative approach to solve challenges with disruption and unpredictable times in classroom learning. This study investigated how Ghanaian teachers can use the flipped classroom as an alternative instructional approach to support the existing blended learning approaches that can help students learn in difficult times.

RESEARCH AIM AND QUESTIONS

This study aimed to investigate the impacts of the flipped classroom on student learning and was guided by the following research questions:

- What are students perceptions about learning in a flipped classroom environment?
- What impact does the flipped classroom approach have on student learning?
- What challenges do students face learning in the flipped classroom environment?

LITERATURE REVIEW

Researchers have found flipped classrooms beneficial despite different views expressed by students and teachers. Flipped classrooms have provided students with foundational knowledge at home, reserving in-class time for concept application and mastering critical thinking skills (Gough, DeJong & Grundmeyer 2017). The positive benefits of the flipped classroom have been shown along with some negative outcomes, based on the context of success. Flores, Del-Arco, and Silva (2016) argued that the flipped classroom is a unique instructional model that encourages a different classroom culture with the help of technology to broaden 21st-century learning styles. Other studies have argued that a higher standard of effective teaching and learning in the future hoves around the flipped classroom approach (Bernard 2015; Zainuddin & Halili 2016). O'Flaherty and Phillips (2015) concluded that the flipped classroom is an effective approach where students engage in higher-order thinking activities that foster collaboration to solve problems, explore concepts more profoundly, and develop authentic assessment tasks.

Student motivation influences learning, and the success of the flipped classroom learning environment largely depends on the motivation and amount of out-of-class activities students undertake (Abeysekera & Dawson 2015). The in-class time utilized for discussions encourages students to be active participants, thus facilitating their need for autonomy and competence. Advocates of the flipped classroom recommend diverse individualized in-class activities so that the teacher can assist more students. In Higher Education, in-class time is recommended to focus on knowledge application which may allow the teacher to provide feedback and detect student errors (Hashim & Shaari 2020). Lai and Hwang (2016) found enhanced student learning outcomes, increased achievement, and satisfaction associated with the flipped classroom through engaging in problem-solving activities. Köroglu and Çakir (2017) reported that students experience learning activities that provide opportunities for performing higher-order thinking activities after acquiring knowledge and learning skills. In addition, other studies have reported improvement in cognitive learning outcomes and students' motivation to increase learning outcomes (Reyes-Lozano, Meda-Campana & Gamboa 2015).

Other researchers have presented critiques of the flipped classrooms as ineffective. They based this view on students attitudes towards video lectures (Keetle 2013; Chen 2016), lack of out of class support (Schultz, Duffield, Rasmussen & Wageman 2014; Bhagat, Chang & Chang 2016), low self-regulatory abilities (Sun, Wu & Lee 2017; Sun, Xie & Anderman 2018), level of pre-class preparation (Wang 2016; Lai & Hwang 2016), inability to ask questions during out of class learning (Fautch 2015) and an increased amount of learning tasks (Snyder, Paska & Besozzi 2014; Wang 2016). Other studies have found a lack of and poor ICT resources, such as internet access and poor network connections (Clark 2015; Chen 2016), access to technology (Du, Fu & Wang 2014; Sandhu, Sankey & Donald 2019), lack of ICT skills and competencies (Chen 2016), high cost of ICT equipment, tools and Internet bundles (Roehl, Reddy & Shannon 2013; Moffett & Mill 2014) which all hinder effective learning in the flipped classroom approach. These critiques and challenges were found to contribute to students developing negative attitudes toward the flipped classroom approach.

Students perceptions and learning outcomes have been used to evaluate the effectiveness of flipped classroom approach. There is evidence to show the students perception of FCA on learning outcomes in terms of student engagement (Chen Hseih, Wu & Marek 2017; Wright, Greenfield & Hibbert 2017), student collaboration (Mzoughi 2015; Koh 2019), and learning skills (Mortensen & Nicholson 2015; Sahin, Cavlazoglu & Zeytuncu 2015), course satisfaction (Sommer & Ritzhaupt 2018; Strelan, Osborn & Palmer 2020). Other studies have revealed general positive perceptions towards the flipped classroom. Du, Fu & Wang (2014) indicated that students participating in technology-rich environments learn with ease because the technology enabled the ability to explore the content and increased interest in the content. Taylor, McGrath-Champ, & Clarkeburn (2013) explored students perceptions on flipped teaching using podcasting and a team-based learning environment. Students reported the podcasts were an essential resource that helped them with collaborative classroom activities where they could interact with each other. Some studies have also reported that technology knowledge promotes effective active learning activities. Mitchell (2017) has noted that using technology for collaborative learning is valuable since it is accessible anywhere, anytime, and enhances the ability of students to work in various group activities. Sandhu, Sankey & Donald (2019) used technological resources to introduce differentiated instruction and found that the participants acknowledged that technological tools enhanced their learning outcomes.

While the studies reviewed indicated that comprehensive research on student perception of the flipped classroom approach had been conducted, there are limited studies on perception and the nature of student experiences relating to the flipped classroom approach in teacher education during difficult times or uncertainties such as the COVID-19 pandemic. This research gap can be filled by exploring how students experienced flipped classroom and blended approaches to learning

during the pandemic. By exploring student experiences, the purpose of this study is to provide information on students attitudes, perceptions, and how to motivate students to learn in an FCA environment. A flipped classroom is a new approach in developing countries, especially Ghana, and researching it could reveal how it can be used when there is no green light for the popular regular face-to-face teaching. The research results are expected to provide information on how flipped classrooms can be used as a teaching approach to bring improvement in teaching and learning, particularly at higher education levels. Specifically, this study will give an in-depth understanding of integrating technology into teaching and learning in STEM classes in Ghanaian teacher education after several attempts to improve ICT use.

RESEARCH METHOD

Research design

The study utilized a mixed case study research design with triangulation to collect data through a survey and focus groups. The case study design was used to investigate the experiences and perceptions in the flipped classroom among undergraduate students who were in pre-service teacher training. The survey as part of descriptive research was used to collect data on participants' beliefs, attitudes, and interests using questionnaires (Bartlett, 2005). Focus group data on participants' nature of experiences in the flipped classroom approach were collected. The research design was based on an intervention and mixed methods for data analysis.

Participants

This study involved two groups of students from the College of Education. The tutor employed the flipped classroom approach at the College during the 2020/2021 academic year due to the COVID-19 outbreak, which led to the closure of all schools and universities. Through the convenient sampling technique, sixty-two students enrolled in a chemistry course were sampled for this study. The participants were majoring in vocational, science, and mathematics programmes and took introductory chemistry as a compulsory course.

Instructional design and procedures

Over eight weeks, this study covered a series of compulsory chemistry course content designed to fit the flipped classroom model (that is, online instruction and face-to-face discussion). The course content, syllabus, reading materials, video materials, and assignments were all prepared and kept in the Google classroom, WhatsApp group, and Zoom platforms created by the students. Students could access the link through their mobile phones or any digital devices sent via their class WhatsApp group. The instructor gave out the objectives, instructions, and rubrics for each week's task and activities at the beginning of the respective weeks for students to know what was expected of them. The unit of each topic was a weekly lesson conducted over 80 minutes, comprising 10 minutes of videos taken out of class, 30 minutes of group discussion in class and online, and 40 minutes of tutorials and reflection in class and on Zoom. The students prepared for each lesson by watching a 10-minute video and reading supporting materials to understand the concept before class. The videos were designed to explain key points about the topic and uploaded as a link on the WhatsApp platform. After watching the videos, discussions were followed up through Zoom meetings and via WhatsApp with the instructor. The instructor then initiated a 40-minute tutorial in-class discussion to build up the basic concepts relating to the topic treated in the video. A 30-minute interactive group discussion was introduced after completing practical work, class activity, and solving a problem. A voice-over PowerPoint presentation or pre-recorded Zoom meeting was used to deliver the online lessons. Students were given an assessment to complete either in groups or individually and graded on the Web-based classroom.

Data collection

A survey was developed and distributed to all the participants, and from which the responses were generated. The researchers designed a 27-question survey to collect data relating to the experiences students had about learning in the flipped classroom environment. The questions were presented using a five-point Likert-scale ranging from 5= strongly agree, 4= agree, 3= not sure, 2= disagree, and 1= strongly disagree (Likert 1932), and poor =1, 2= fair, 3= satisfactory, and 4 = very good. Open-ended questions were also used, which allowed the participants to explain their views on the learning materials, how the content was delivered, learning outcomes, and challenges they encountered during the implementation of the course. Out of the sixty-two questionnaires distributed, 44 respondents, representing 71 %, responded to all the questions and were deemed usable for analysis. A focus group interview was also conducted with 6 randomly selected participants who were part of the total students enrolled in the course, to obtain further information for purposes of clarity. The open-ended focus group interview questions were used to explore students perceived level of experiences with the flipped classroom approach. Details of informed consent and confidentiality were taken into consideration.

Data analysis

The quantitative data were analyzed using the Statistical Package for the Social Sciences (SPSS) software version 27. Qualitative data were analyzed to identify themes and patterns from the phenomenon and commonly repeated elements were identified (Padilla-Diaz 2015). The data were grouped into themes, and the participant description was added (Creswell 2014). To ensure trustworthiness and unbiased data, triangulation was used to validate the results by focusing on specific experiences. The themes that emerged from the survey responses were categorized into attitudes towards the flipped classroom, support, and learning outcomes. The data findings helped determine how effective the flipped classroom model is as an instructional approach for delivering chemistry lessons.

RESULTS AND DISCUSSION

The qualitative and quantitative data analyses are presented below in accordance with the research questions.

Students' general perceptions of the flipped classroom approach

The first research question focused on students perceptions of the flipped classroom approach. In the questionnaire, six constructs were used to determine the general perceptions and satisfaction of the flipped course. The mean, standard deviations and internal consistency are indicated in Table 1.

Table 1: Students general perception and satisfaction of flipped classroom approach

Constructs	Mean	SD	No. of items
Satisfaction	3.50	0.54	1
Teacher support	3.62	0.68	3
Students expectation	3.50	0.58	2
Students engagement	2.49	0.25	5
Usefulness	3.54	0.34	4
Effectiveness	1.50	0.45	2

The students expressed different (both positive and negative) satisfaction about learning in the flipped classroom environment. Of the participants surveyed, 60 % described their general view as good. They used words such as happy, good, quite good. About 40% of the students believed

learning in flipped classrooms was challenging, stressful, tedious, boring, and difficult. Some students expressed their satisfaction with learning in the flipped classroom model, describing it as innovative as the world is changing to technology, and incorporating online learning now will help them in the future. In comparing the means of all the items, the highest was noted in the teacher support category ($M=3.62$, $SD= 0.68$), followed by usefulness ($M=3.54$, $SD=0.34$) and student engagement ($M=2.49$, $SD=0.25$). The overall satisfaction and students' expectation had a mean score of ($M=3.50$, $SD= 0.54$) and ($M=3.50$, $SD= 0.58$) respectively. The lowest mean score was the effectiveness category ($M=1.50$, $SD=0.45$).

Further, in regard to the overall perception of the flipped classroom, responses from the survey show that the participants were satisfied with the flipped classroom course ($M = 3.50$, $SD=0.54$) where students indicated their satisfaction level to be either, 3= satisfactory 4= very good. A correlation results analysis revealed a positive correlation between student satisfaction and other related variables ($p < .05$):

- Instructors' skill, competence, and use of techniques to engage students ($r = 0.63$)
- Instructors explained the concept, and learning materials enhanced my understanding ($r = 0.54$)
- Student perception of knowledge, skills, and experience to use ICT to learn ($r = 0.58$)
- Students' confidence to obtain good grade in course ($r = 0.42$)
- Watching videos, reading materials before class helped me learn more ($r = 0.51$)
- Students' perception of active participation in class discussion ($r = 0.61$)
- Students' confidence learning in flipped classroom ($r = 0.55$)

In addition to the students' high satisfactory level with the flipped classroom approach, the response to the survey question that sought to know their confidence in getting a good grade in the course taught with the flipped classroom, revealed that most of the students agreed or strongly agreed (4 = agreed and 5=strongly agreed) that they could get a good grade in the course ($M= 4.43$, $SD = 0.54$), as shown in Table 2 below.

Students perceived benefits of the flipped classroom approach

The respondents had positive perceptions of learning outcomes towards the flipped classroom model, as indicated in Table 2.

Table 2: Mean value of students' perceived learning outcomes

Constructs	Agree (%)	Disagree (%)	M	SD
I have the knowledge and skills of using ICT to learn	75.3	20	3.75	0.46
Blended learning encourages me to look for extra information about the topic	58.6	31.2	4.00	0.01
I am confident I can get a good grade in this course	97.9	1.5	4.43	0.54
I am more confident in learning in a blended environment than the lecture method	72.3	20.5	2.57	0.98
I watched the videos read materials before class, and it helped me to learn more	68.3	36.8	3.57	0.79
The videos and learning materials are exciting and motivated me to learn	78.4	19.6	3.00	0.82

I was too anxious about blended learning, and now my confidence has increased	62.5	18.4	3.75	0.71
Teacher using different teaching strategies enhanced conceptual understanding	59.4	35.2	3.63	0.74
I participate actively in-class discussion, problem-solving activities than lecture	42.8	48.3	3.29	0.95
Seeing the teacher for face-to-face discussion makes learning easier for me	57.1	28.1	3.43	0.79
The course content was too much, and the blended learning made it easier to learn	64.8	15.6	3.63	1.06
Participating in online group work encouraged me to understand better	15.0	85.7	2.29	0.76

Findings from the survey showed that the participants strongly agreed that blended learning encourages them to look for extra information aside from what the teacher provides them in class ($M= 4.00$). Student views indicate that looking for additional information helps to enhance their knowledge construction, leading to higher confidence to get good grades. The construct – *I am confident I can get a good grade in this course*, had the highest mean value of 4.43 (42.9% strongly agreed). Since students take responsibility for their learning in the flipped classroom, specific skills and knowledge of ICT are essential. About 75% of the participants agreed they had developed skills and experience to use ICT to learn independently ($M=3.75$, $SD= 0.46$). Since watching videos and reading materials before class is crucial in FCA, 68% of the students agreed they were motivated to prepare before class, which helped their learning ($M= 3.57$, $SD= 0.79$). Effective communication and interaction between instructors and students during in-class time are essential in flipped classrooms. Students found that having discussions with instructors in a face-to-face classroom was helpful for further clarification of the videos and reading materials to correct misconceptions. About 57% ($M= 3.43$, $SD= 0.79$) of the participants agreed that seeing the teacher for face-to-face interactions and discussions enhanced their understanding. Many students (59%) agreed that during the class discussions, instructors applied different strategies to explain concepts. The participants were confident and optimistic that instructor use of a blended learning approach to deliver the course motivated them to learn more.

In addition, the results show that students' motivation encourages and boosts their confidence to learn. Since the FCA is a new instructional model in Ghana, many students are anxious about it. Although many students (62.5 %) felt anxious about the approach, their confidence level increased ($M= 3.75$, $SD = 0.71$). In this study, the lowest mean value was found for interacting with peers in the Google classroom ($M=2.29$, $SD = 0.76$). Students valued working with peers, but many of them (85%) disagreed that participating in an online group discussion encouraged them to learn the course as opposed to the traditional lecture method.

Student perceptions of the impacts of the flipped classroom on their learning outcomes

Content analysis from the survey was compared to the focus group data to confirm the participants' perceptions and experiences. Overall, students noted that the flipped classroom approach contributed to a more profound understanding of the content. The students perceived that the flipped classroom helped them to do complex tasks. Students reported that the flipped classroom learning environment is an avenue that provides the opportunity to think deeply about their tasks, which is a component in scientific inquiries. They reported that they understood the process of scientific investigations after the course. They also noted that the flipped classroom environment creates an avenue for synthesizing information to make meaning. Some of the students noted that

flipped classrooms enabled them to synthesize information to develop new knowledge as they go through the active learning activities on their own at their convenience.

Enhanced understanding of learning concepts

The findings revealed that flipped classrooms foster a deeper understanding of concepts and contribute to more profound learning by the respondents. The students perceived the flipped classroom environment as helping them to complete difficult tasks and to think deeply about the tasks. Student 3 noted:

“learning in the flipped classroom encouraged and motivated me to master knowledge searching skills, which will help me connect with other aspects of my life. The use of in-class time for deliberations on the problem-solving questions makes students master the skills to perform difficult tasks ”. [Student(S)3]

Understanding scientific inquiries is one of the advantages of the flipped classroom, where students engage in active learning. Students understood the process of scientific investigations after being exposed to the flipped classroom.

Student 1 noted:

“As we engaged in inquiry learning enabled us to process information to construct knowledge by creating new ideas, which provide the opportunity to increase my understanding of the topics.” [S 1]

The findings showed the flipped classroom environment creates an avenue for synthesizing information to make meaning. Some of the students explained that the flipped classroom enabled them to synthesize information to develop new knowledge as they go through the active learning activities on their own at their convenience. Student 4 noted that:

“ I find it much more beneficial because it helped us gather new information since an update of information is located on the internet every day.” [S 4]

Collaborating with peers

The responses showed that the use of in-class time for deliberations on the problem-solving questions makes students master skills to perform problem-solving. The students were optimistic that interacting and collaborating with peers provided an opportunity to solve challenging tasks during their group work. Student 2 stated:

“Working with peers helped me finish the tasks on time and fostered effective peer teaching as we share ideas among ourselves.”[S 2]

In addition, Student 5 noted:

“The flipped classroom is good because we can share ideas with peers, which enhanced our understanding of the concept better when working with peers than a teacher teaching us.” [S 5]

One essential element of the flipped classroom is teacher-student interactions. Students perceived the flipped classroom approach as effective since they had a better chance to receive constructive feedback from instructors. They had the opportunity to meet the instructor in class for discussions and reflections on the videos, reading materials, and other incidental tasks. This helped boost their understanding of the concepts since the instructor used that free time to provide feedback, explain concepts students find difficult, and clarify their misconceptions. These experiences encouraged students to go through the various stages of finding answers to the assigned problems, thus

enhancing their understanding of the scientific inquiry. Some students expressed their positive experiences in collaborating with peers, as follows:

“During the out of a class session, we were encouraged to share ideas during the discussion with peers to clear any misconceptions we had.” [S 3]

“The tutor’s presence makes me feel comfortable as he helped to discuss our questions to understand the topic better.” [S 6].

“We were able to discuss our problems we did not understand with the teacher who explained to us and sometimes corrected our misconceptions.” [S2]

Another learning outcome the students mentioned was meeting their course expectations through active collaborating activities. Some of the students felt more comfortable working with peers in the group to build their confidence to learn. In addition, the engagement enhanced interpersonal interaction, and the group activities helped students become more open-minded as they shared ideas, discussed, reflected, and came to common conclusions. Consequently, students were of the view that the flipped classroom fosters effective peer teaching as they were able to share ideas. The students preferred the approach since it promoted their interaction and their communication skills. Student 5 was of the view that:

“Working with other students helped us learn the concepts. Through the discussions, we can ask our peers for clarification and communication to better understand the concept”. [S 5]

Another participant reiterated that:

“Because the interactions with our teacher and other students are cordial such to an extent, we don’t feel unwilling to answer and ask questions in the class.” [S 1]

Further, Student 2 noted that:

“The flipped classroom creates opportunities for us to be more interactive as we collaborate and discuss to bring out different ideas and views to be shared. Through the collaboration, we understand the concept well”. [S 2]

Student 4 added:

“Our expectations increased when collaborating with peers through the class discussion. We could come to a common agreement regarding presenting results in our group project”. [S 4]

Critical thinking

Some of the students perceived the flipped classroom approach as promoting divergent ideas. Students’ views revealed that the flipped classroom was a means of developing convergent ideas among peers during group work. This helped them become more confident as they learned, leading to positive knowledge construction and enhanced convergent skills to explore new information further.

Student 2 illustrated as follows:

“The course materials were beneficial in so many ways I would say, for instance, we can use them in everyday life-solving everyday problems since we learn outside the classroom. We can apply what we learn to solve problems which is quite good ”.[S 2]

In addition, student 6 supported the view and noted that:

“We demonstrated that what we are learning in the classroom is linked to the real-life situation as we look for ideas through brainstorming to solve problems. This helped us understand the concept more and improve our critical thinking”. [S 6]

Challenges of using the flipped classroom approach

Even though the students’ level of satisfaction was generally very high in terms of positive perceptions, they also pointed out some challenges they encountered in the flipped course. The responses to students’ perceived challenges are shown in Figure 1 below.

About 50% of the students surveyed responded that taking the course was more challenging as it increased their workload and they preferred taking the course face-to-face only. They felt the course content had many learning areas, tasks, and independent activities such as out-of-class tasks. About 88% of the participants surveyed agreed that the cost of ICT resources, such as data bundles, and android phones made it difficult for them to learn. As a result of the lack of ICT resources, 75% of the students found it challenging to access the learning materials, while 72% of the respondents indicated they had no knowledge and skills to use digital tools and online learning platforms. In addition, 25% of the students agreed that they had issues with access to the Internet and poor network connectivity at home to support their learning. These challenges might have affected students’ preparation, participation in online discussions, and submission of assignments, leading to negative attitudes, motivation, and learning confidence.

Pre-service teachers identified challenges

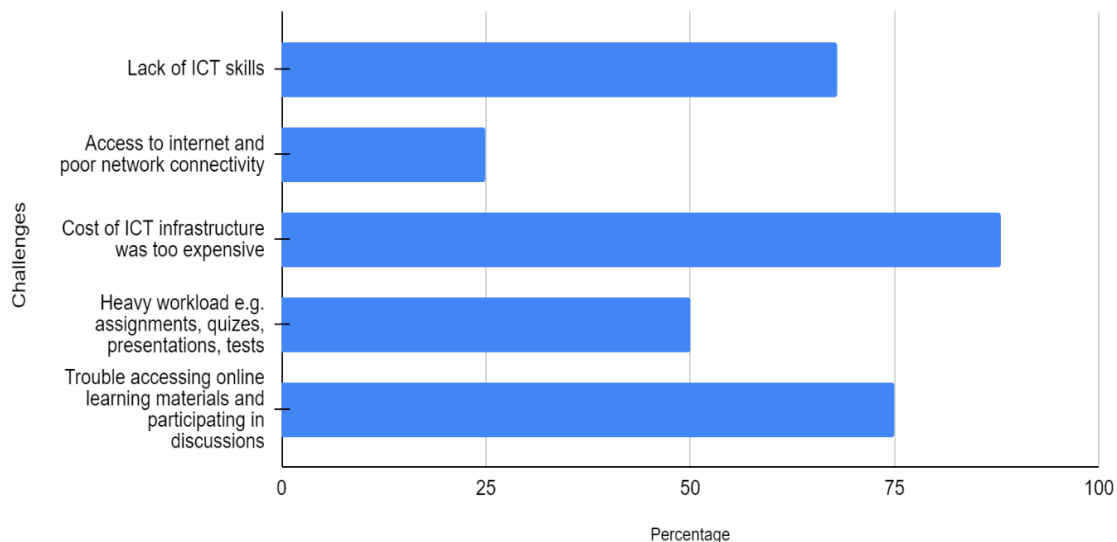


Figure 1: Responses on students’ perceived challenges

During the focus group interviews, the students further highlighted the barriers and challenges shown in the survey responses in Figure 1. Although the students were satisfied, they further expressed their views during the focus group interviews on the effectiveness of learning in the flipped classroom environment. They emphasized poor network connections and Internet access as factors that impacted their learning. They noted that most students could not join the online discussions due to poor network connections and lack of Internet. They reiterated the lack of Internet facilities in their homes to watch the videos or join online discussions, so they were not enthused in taking the course. Some students expressed their difficulty in learning in the flipped classroom environment as follows:

“The internet connectivity is deficient in our homes, and so doing online studies is very difficult. Many students did not participate because sometimes you will join the online class, and it disconnects, and before you come back, the lesson is over.” [S1]

“It was challenging to understand the concept because of the internet, and sometimes the connection was poor.” [S3]

“Because of the bad network, it was difficult for me to understand some of the topics since it was challenging to access the class materials. Sometimes I could not join the online discussions for interaction with the lecturer.” [S 4]

“We have challenges with the internet connectivity, and the poor network disruption makes it uncomfortable to learn.” [S2]

“We have challenges with the slow network and poor internet connectivity, which putten together makes the face to face better than flipped classroom approach.” [S5]

In addition, students noted that the cost of data bundles was a challenge for them as there was no Wifi available, so they had to rely on mobile data on their android phones or laptops. They shared that data bundles were expensive as they had to use lots of data watching videos, joining online discussions with the teacher for a particular session, and submitting assignments. All these put an extra cost on their parents, thus demotivating them to participate actively in the class, especially in the virtual session. Some comments that illustrate the student views include:

“The major challenge is the cost of data and internet connectivity. If the government can make available Wifi to connect the whole campus and classroom to the internet, that will be good ”. [S3]

“Apart from the problem of the internet system always been slow resulted in a shortage of data bundle. [S2]

“Learning in a flipped classroom environment is expensive because of the cost of the data bundle involved data.” [S 6]

Another challenge the students faced was a lack of skills to use ICT. Some students found it challenging to use Zoom, prepare PowerPoint slides, type assignments, and upload them on the Google classroom platform due to a lack of skills in ICT. Some of the students stated:

“The online session does not help us mainly because of a lack of skills in using some ICT tools and platforms. For example, you have to type the assignment text, unlike the face-to-face classroom where you make handwritten submission”. [S 5]

“Some of us do not know how to use computers to type, design Powerpoint, and upload documents in the Google classroom.” [S4]

DISCUSSION

This study aimed to examine the impact of the flipped classroom on student learning. The findings indicate that flipped classrooms have a positive impact on student learning. Although the students noted that the content and structure of the course were too much, most of them felt that approach helped them learn and motivated them as well. The students displayed high satisfaction levels with taking the course through the flipped classroom approach and showed positive attitudes toward it. They indicated that the approach was effective as they met their expectations and experienced learning gains. These findings are similar to previous research results (Zainuddin & Attaran 2016; Jensen, Holt, Sowards, Ogden & West 2018). In addition, the results revealed that the flipped classroom is beneficial for students because the learning materials motivate and provide an opportunity for them to learn at their own pace, a finding consistent with that of Olakanmi (2017).

The quality of learning in FCA depends heavily on students preparation in the pre-class activities. Students reported that watching video lectures ahead of in-class time helped them prepare adequately for other activities, a finding that is supported by earlier studies (Grypp & Luebeck 2015; Wang 2016). Further, the video lectures and other learning activities motivated students to search for further information. This was also noted in other studies in which students reported that after pausing, rewinding and taking notes from the video lectures this helped to boost their understanding (Abeysekera & Dawson 2015; Ramnanan & Pound 2017). Students believed that the FCA approach enhances their level of engagement and satisfaction, which are essential elements of teaching and learning. Previous studies have pointed out that the quality of the flipped course video lectures and learning materials affects students' level of engagement and satisfaction (Al-Zahrani 2015; Al-Sudais 2019).

Regarding general perceptions, students had positive perceptions towards the flipped classroom approach. This finding is supported by those of previous studies (Bhagat, Chang & Chang 2016; Chen, Chao & Hung 2018; Xiu, Moore, Thompson & French 2019). The positive attitudes expressed among students from the FCA activities were consistent with other studies with students practicing outside of the classroom to reach high levels of understanding of concepts, knowledge construction, and mastering scientific inquiry skills (Turan & Goktas, 2016; Chen Hsieh, Wu, & Marek 2017). The design of the flipped classroom course was found to be encouraging and the finding is consistent with other studies for motivating students towards effective peer collaboration and interaction in friendly group working conditions (Soult, 2016; Bakar & Latif 2016).

However, students also developed negative attitudes towards the FCA based on the structure of the course, lack of ICT resources and infrastructure. The barriers and challenges noted by the participants are similar to previous study findings that the cost of Internet data and lack of resources led to students' negative perceptions of the flipped classroom (Sinha & Bagarukayo 2019). The study findings are also similar to other studies that found mixed views and perspectives. In a study by Anderson and Brennan (2015), few students reported the flipped classroom approach was unhelpful, which is the reverse in our findings. However this disagreement with other student perceptions might be attributed to challenges students encountered taking the course.

The students indicated that flipped classroom learning improved their learning outcomes and achievements regarding collaborative learning, knowledge construction and understanding, and critical thinking. The students found the approach to be more engaging than the traditional face-to-face classroom leading to most students developing different learning outcomes. The findings of this study shows that most students agreed that video lectures, course content, and other learning

materials were exciting and motivating; a finding that was also reported in earlier studies (Gilboy, Heinerichs & Pazzaglia 2015; Zainuddin & Attaran 2016). Most students agreed that the flipped classroom could help create a learning community among peers. The result is similar to Mzoughi's (2015) study, where he found most students had positive engagement and interaction with peers in a flipped classroom course. In addition, the results of our study showed that the flipped classroom creates opportunities for student-students and instructor-students interactions. The students mentioned their interaction with the helpful instructor and the findings lend support to the view that the teachers' learning coach and guide role is essential for effective use of the FCA. Further, students saw working with peers as applicable since it helped to develop better attitudes for learning experiences. These active learning activities were also found to enhance students' social skills development in earlier studies, as they collaborated and engaged with peers (Rotellar & Cain 2016; Chien & Hseih 2018).

The students reported being in a flipped classroom learning environment enhanced their understanding of scientific concepts. Several studies have reported increasing students' understanding of concepts through technology (Mitchell 2017) and in a flipped classroom, an opportunity is created for students to learn independently outside of the classroom space, which is an essential element for achievement (Uzunboylu & Karagozlu 2015). Wright, Greenfield & Hibbert (2017) reported that active engagement of students in the class discussions helped reduce errors, and through that, struggling students are identified and assisted. In addition, this study showed that the flipped classroom enhanced the development of students' critical thinking skills. Students learning through the flipped classroom approach are engaged in tasks that enhance the development of thinking skills as they seek solutions to problems (Wanner & Palmer 2015; DeRuisseau 2016; Aldaka 2020). However, these strong positive students' views indicate that learning outcomes such as achievement can be used to assess academic performance.

Despite the positive perceptions about the flipped classroom, the students also indicated that learning under the flipped classroom approach could be challenging. Our study shows that the lack of ICT infrastructures such as Internet data bundles and digital tools hinders student learning in a technology-enhanced environment. Students also mentioned that data bundles and android phones were too expensive for them. These findings align with other studies emphasizing access to ICT resources and access to the Internet and its associated high-cost Internet and digital tools (Wang 2016; Chen 2016; Sinha & Bagarukayo 2019; Bubou & Job 2021). In addition, our study showed students lacked the requisite skills to use ICT tools and navigate through the new online platforms, a finding supported by other earlier studies (Chen, Wang & Chen 2014; Leo & Puzio 2016; Ngo & Eichelberger 2021). These findings imply that students lack self-efficacy and technological competence to learn in an online learning environment effectively. These barriers according to the students affected their preparation and learning in-class activities of the FCA, which is also supported by Akçayır & Akçayır (2018). Therefore, adequate preparation and support must be considered when planning the FCA course.

CONCLUSION

The flipped classroom approach has been used in teaching at different educational levels, including secondary, college, and university levels, to highlight its benefits; however, less attention has been focused on students. Most of these studies have highlighted the learning outcomes and have ignored the aspect of developing teachers to accept technology integration teaching as a professional development approach as they enter the classroom right after graduation. Building student confidence in using new techniques such as the flipped classroom is still lacking in the literature, especially in such times like the COVID-19 pandemic where the future of education is uncertain. The findings of this study on flipped classrooms are encouraging for teacher education, and there is the need to highlight certain factors when implementing the approach. First, access to technological tools for communication (such as, computers, android phones and internet facilities.)

Also, the course content and learning materials such as videos, powerpoints slides, tasks, classroom activities, and assessment should be well chosen and prepared to be more engaging for students. The instructor's role and the type of interactions presented with students are critical in achieving flipped classroom success. The instructor should guide students throughout the activities to provide immediate feedback for an effective learning process.

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