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# Use of *Vclass* in Mathematics Education Delivery: The UEW Experience

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**Abstract.** The onset of Covid-19 pandemic has compelled institutions of higher learning to experiment with various online learning management modes, in lieu of the traditional face-to-face mode of instruction. However, conclusions about the effectiveness and sustainability of these new learning modes are not well-established. This study explored experiences of mathematics education lecturers and students who were first time users of an online learning management system referred to as *UEW vclass*. The sample comprised 10 students pursuing the degree of Bachelor of Mathematics Education and four lecturers who taught them five different courses at the University of Education Winneba (UEW), Ghana. Data were collected via interviews, and a survey item created on Google forms and administered through WhatsApp pages of respondents. The results of SWOT analysis show that lecturers found the *UEW vclass* useful and amenable to their teaching and assessment practices. As first-time users, the lecturers found the course creation, online delivery and e-assessment practices exciting, though challenging in terms of their digital and pedagogical skillset. Internet connectivity and system errors affected lecturers' real-time lesson delivery sessions while the trustworthiness of e-assessment scores was a serious concern. Students found the *UEW vclass* suitable, convenient, interesting, and user friendly. However, students' challenges were login, network, timing, real-time feedback and typing mathematical symbols. The paper therefore recommends an upgrade of network bandwidth to improve access, a built-in math symbols app, training and orientation of lecturers and students. The hybrid mode of learning is also recommended to enhance learning outcomes.

**Keywords:** Mathematics, online experiences, LMS, UEW *vclass*

## 1 Introduction

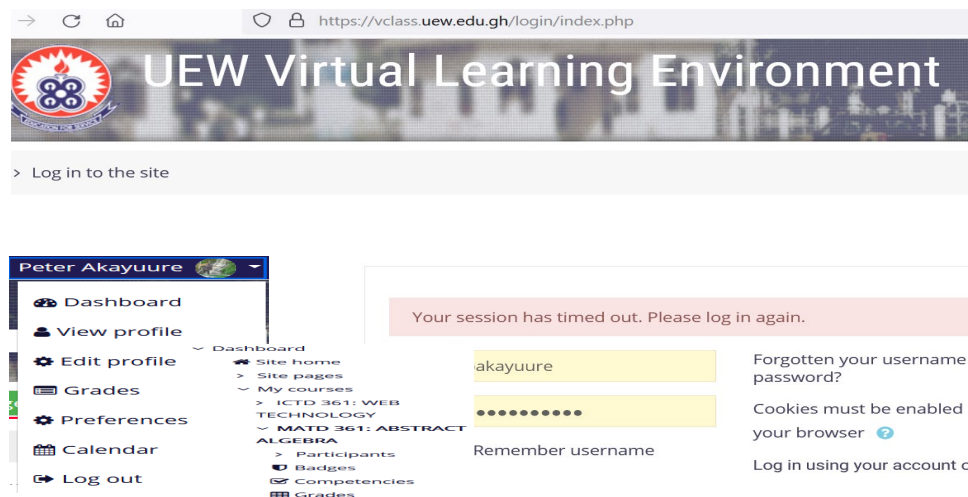
The advent of the Covid-19 pandemic has rapidly influenced every domain of human existence and drifted human undertakings to a *new normal* in which social distancing becomes the norm. With the emergence of the new normal, educational institutions worldwide are beset with teaching, assessment and learning sustainability crises [1]. These crises compelled many educational managers and lecturers to rethink mathematics educational access and delivery, while students strive to adjust to new learning systems external to the orthodox face-to-face mode. The quest to determine *which* and *how* learning platforms can be used for mathematics educational delivery remains unsettled.

Institutions of higher learning are quickly adapting to the crises. Universities across the world were obliged, after March 2020 lockdowns, to quickly migrate into purely

online modes [2]. The people's Republic of China where the Covid-19 first hit, for example, moved fully into online platforms and implemented the "School's Out, But Class's On" policy to promote broad-based online teaching and learning to sustain academic work [3]. Universities in developing countries like Ghana, though unprepared, were also coerced to experiment with various online learning management systems in a bid to continue educational delivery [1, 4]. For example, new and emerging digital learning platforms such as Moodle, Sakai, Zoom, Edmodo, Quipper, Google meet, have been experimented in schools without prior evidences of their effectiveness, successes and shortfalls. For the past one and half years, there has been unprecedented push in Ghana towards online teaching, learning and assessment. Providers of commercial digital learning platforms also rushed to provide support and solutions to educational delivery, sometimes for free. Government of Ghana directives and regular updates of tensions and increasing spread of Covid-19 also obliged universities to sustain the drive towards online learning [1].

The University of Education Winneba (UEW) trains competent professional mathematics teachers for all levels of education in Ghana and the West African sub-region. Prior to March 2020, the move to online mathematics instructional delivery was met with resistance due to faculty deficiency in digital pedagogy, low ICT infrastructure and resources, as well as a lack of student support systems. When Ghana recorded its first case of the Covid-19 in March 12, 2020, culminating in lockdowns and closure of all institutions on 16th of March, 2020, the academic calendar was disrupted [4]. UEW was therefore compelled to devise innovative ways of using Learning Management Systems (LMS) to enable students to learn at home amidst the pandemic, to bring the 2019/2020 academic year to a successful close. After some few weeks of experimenting various low cost and open learning sources such as Zoom, WhatsApp, Google class and Telegram, UEW management finally mandated its faculty and students to use the LMS called *vclass* as an official platform for online learning [5].

The UEW *vclass* is a Moodle based platform enhanced with BigBlueButton for live video lecturing which can be recorded, saved and played back online or offline. In the *vclass*, lecturers are given privileges to create and develop courses, upload course materials onto the online platform and subsequently engage students in learning using e-resources such as chats, forum discussions, assignments, quizzes and downloadable materials. All lectures, live videos, study materials and assessment data are stored in UEW server for retrieval. To facilitate its use, UEW ICT directorate provided short time training and hotline support system for faculty to create courses, teach in front of a computer screen and implement e-assessment. Students were also given virtual orientation on how to login to the *vclass*, enroll for courses, access study materials and participate in lesson delivery and assessment online, while at home. A diagrammatically representation of the UEW *vclass* is shown in Figure 1.



**Fig. 1.** The interface of the UEW vclass

As a result of the Covid-19 pandemic and digital experiences, UEW plans to emphasise, consolidate and serve as a pace setter of online instructional delivery for its regular, sandwich, and distance modes beyond the Covid-19 era. However, due to the swift and abrupt nature of moving courses online, and as first-time users of the *vclass*, lecturers and students are likely to encounter challenges or discover some potential of the *vclass* [4]. In other words, attempts to sustain this new innovation of using the *UEW vclass* for mathematics education delivery in UEW require an understanding of the new dilemmas and contextual issues regarding ICT infrastructures, faculty capacity, and students' support and welfare. Around the world, researchers and educators are trying to research into the paradigm shift from the face-to-face learning to online education and users' experiences [6]. This is because understanding users' experiences in online learning platforms is crucial to its success and sustainability. This study therefore mirrors students' and their lecturers' experiences in the use of the *UEW vclass* platform to learn various courses in mathematics education in UEW.

The study was guided by the following research questions:

1. How do lecturers and students experience the use of *vclass* to teach and learn mathematics courses?
2. What are the challenges faced by lecturers and their students in using the *vclass* in the teaching and learning of mathematics courses?

It is hoped that this empirical data on how lecturers and their students experience and adjust to the new learning system to meet curriculum requirements would help in decision-making towards improvement and sustainability of *vclass* in UEW. Evidence from this study would also provide first-hand information that would shed light on the strengths, weaknesses, opportunities and threats (SWOT) regarding deployment of emerging digital platforms in mathematics instructional delivery in the Covid-19 pandemic era and beyond, in developing countries such as Ghana.

## 2 Related Literature

Advances in digital technology have given birth to a new era referred to as the Fourth Industrial Revolution (4IR). The 4IR comprises technology-based tools and digital platforms which are currently transforming the teaching and learning of mathematics. As a result of the Covid-19 global pandemic, there is a growing body of research currently focusing on technology platforms in education [2, 7]. These studies have shown that integrating digital tools in mathematics pedagogy supports learning, and has positive effects on students' mathematics performance. A study by Marpa [7] found that the use of technology in mathematics teaching bears relevance and significance to the mathematics teachers because they develop positive attitudes toward it. Johns and Mills [2] reported that online mathematics tutoring can be as effective as face-to-face tutoring on students' mathematics achievement and positive self-concept, and attitudes toward mathematics learning. Mulenga and Marbán [6] examined prospective teachers' online learning mathematics activities in the age of the Covid-19 pandemic. Cluster analysis revealed that students engaged in the online learning of mathematics activities exhibited excellent online learning skills for mathematics in technology-rich environments. Ricker [8] utilised Hrastinski's theory of online learning as online participation and Moore's 3 types of interactions model of online student behaviour to determine whether 2 types of student LMS interactions could predict mathematics course performance. The study concluded that student clicks navigating the course content pages, and the number of times a student accessed resources, predicted student mathematics performance after allowing for the effects of student demographic covariates. Finally, according to a study [6], online learning in mathematics maximises personalised education of every student, and promotes sense of freedom during the Covid-19 isolation period. The study proposes a comprehensive and advanced pedagogic design to render lessons through virtual classrooms during and beyond the Covid-19 age.

While there are evidences in the literature about the advantages of online mathematics instruction, other studies have reported various challenges and barriers that users of technology encountered in the learning process [6]. In terms of challenges Agormedah, et al [4] in a descriptive phenomenology study, found that poor internet connectivity and high cost of data were challenges faced by students. Owusu-Fordjour, et al [9], said the high cost of internet data is one of the major challenges hindering students' online learning in Ghana. Tsitsia, et al [10] revealed that students are also distracted mostly by home related factors. They recommended a blended teaching to manage cost and internet data usage, and prepare students in physical and virtual classrooms experiences.

In terms of barriers, Mailizar, et al [11] categorised online learning barriers into student, teacher, curriculum and school levels. Student level barriers include skill and knowledge, motivation and e-learning infrastructure. Teacher level barriers comprise confidence, knowledge, belief and experience. Curriculum level barriers include structure of contents, assessment and e-learning resources that are aligned to the curriculum while at school level these consist of availability of software and hardware, internet, textbooks, school policy, time and technical support. These evidences suggest that the use of online learning platforms come with various challenges. Naidoo [12] found that most mathematics teachers are hesitant in using technology in their classroom, even though there are many digital applications and websites that can support learning and

improve mathematics achievement. In the case of *vclass*, little is documented about users' experiences and challenges in learning mathematics, particularly in developing countries such as Ghana. This study seeks to fill the gap and to provide information about its sustainability. Due to the Covid-19 pandemic, Mulenga and Marbán [6] posited that "we are being challenged to think in different ways, to solve problems together, to collaborate and to communicate in different ways, to educate and be educated in a different way" (p. 3). In view of this, evidence from this study may serve as a lesson for the mathematics education community of learning regarding the prospects of deploying online learning management systems.

### 2.1. Conceptual Framework

The study focused on first time users' experiences of the LMS referred to as *vclass*. The users' experiences are conceptualised and framed as Strengths, Weakness, Opportunities and Threats (SWOT). These are constructs adopted from SWOT analysis conducted by Businessmen to identify viability of business setups. The strength of *vclass* refers to its ability to replace face-to-face instruction and facilitate effective online teaching, learning and assessment of mathematics. To support the use of the *vclass*, it is expedient to determine from the users' perspective if this strength was met, and to identify the weakness encountered by users in terms of challenges and barriers. As a new mode of instructional delivery, it would also be apposite to understand the opportunities that exist with deployment of *vclass* in teaching and learning mathematics as well as the threats resulting from refusal or complete abandonment of the system at student, lecturer or school levels.

## 3 Methodology

This qualitative study relies on the interpretive paradigm, and views experiences of people as ontologically internal and epistemologically subjective in nature. Therefore, the study views lecturers and students' *vclass* experiences as personal constructions which are subjectively and qualitatively interpreted. Collecting and analysing qualitative data provides better opportunity to understand practicality/usability issues as well as challenges of lecturers and students in the use of the *vclass*.

### 3.1. Participants

Participants for the study comprised ten students (3 in 4<sup>th</sup> year, 3 in 3<sup>rd</sup> year and 4 in 2<sup>nd</sup> year), and four of their lecturers. The students were pursuing the Bachelor of Mathematics Education programme, UEW. These students were contacted randomly, and they voluntarily shared their experiences in the use of the *vclass*. By the structure of UEW mathematics education courses, the students were exposed to ICT courses including Introduction to use of ICT tools, Basic programming techniques and Courseware design using multimedia tools. All of them disclosed they were intermediate users of ICT tools. Five of the participants reside on the university campus. The other five also

reside outside campus, and did not have access to the university Wi-Fi network at their place of residence, except when on campus.

The four lecturers engaged the students in different courses using the *vclass*. One lecturer taught Ordinary differential equations and Partial differential equations. The other three lecturers taught Mechanics, Vector algebra and Methods of teaching senior high school mathematics respectively. Two were male lecturers who described their ICT proficiency as basic, while one male lecturer was at advanced proficiency level in ICT. The only female lecturer described her ICT proficiency level as intermediate. To assure the participants of their anonymity, only pseudonyms were used in this study.

### 3.2. Data Collection and Analysis

Data were collected through an open-ended item survey, and interviews. The open-ended item was constructed in Google forms to gather data on challenges encountered in using the *vclass*. Accompanying the Google forms was an informed consent message outlining the study purpose, the use of the data for publications, and participants' right not to respond to the item. Unstructured interview sessions were also conducted online with the ten students and four lecturers to share their experiences and challenges of *vclass* usage.

The interview data were transcribed and analysed by coding and categorising into themes and subthemes based on the SWOT constructs described earlier in this study. Open coding was first done to familiarise with the data, scrutinise and organise codes. This was followed by processing of codes, creating connections, and the grouping of excerpts of data into themes reflecting SWOT constructs in using the *vclass*. As recommended by Fusch and Ness [13], the principle of data saturation was applied to end further codes when it became obvious that responses produced were similar, or no new information or further coding were feasible. To ensure trustworthiness, clarity and accuracy of results, member checking was undertaken with participants. The data file on challenges in the use of *vclass* was download from Google forms. The file was then imported into INVIVO 12.0 software and run to obtain word cloud and reference codes of words that demonstrate the frequency of challenges encountered by students and lecturers.

## 4 Results

This section presents the experiences and challenges of the lecturers and students who used *vclass* as a teaching and learning platform. The interviews revealed that lecturers relied more on their personal computers, while smartphones were the main devices used by students in most of the interactions in the *vclass*. All the students interviewed admitted they mainly used the mobile phones, but occasionally used personal computers or tablets. This means that the students relied more on their own devices and data to access the *vclass* since they could not access the university Wi-Fi at home. When students rely on their own data to connect online, it is likely that they may not visit the *vclass* frequently for interactions, downloads or uploads of study materials [8].



#### 4.1. Mathematics Lecturers' Experience in the Use of *Vclass*

The interview responses of the lecturers who shared their *vclass* experiences are presented in the following subthemes.

##### A. *Vclass* as a Course Creation Platform

The lecturers had different expressions regarding the user friendliness of the *vclass*. They said that the *vclass* was quite convenient, exciting and flexible to use in creating courses online in one's own time and space. The lecturers, however, pointed out that they had limited digital expertise to create courses on *vclass* but were able to learn new digital skills in content generation and course development, as articulated in the following excerpts:

*Akos: the vclass has provided flexibility in terms of creating the course and course delivery. Of course you can be at the comfort of your home, create the course and upload online. . . Again, in term of course creation . . . , it has helped to learn new technical skills . . . learning how to create the course and upload them online.*

*Aliu: We don't have even the expertise of creating the course online. So we were experimenting, try and error kind of . . .*

These responses support previous findings [11, 12] that first time course creators are often threatened by limited digital skills. However, they also tend to develop new digital pedagogies when they engage in developing courses online.

##### B. *Vclass* as a Platform for Delivery of Lectures

In *vclass*, all instructions are delivered to students online by text, audio and/or video with BigBlueButton. Expressing their experience of *vclass* lectures, the lecturers claimed the *vclass* was a suitable platform for virtual communication, collaboration and interaction with students, and for monitoring attendance. They admitted, however, that they had limited skills in presenting mathematics content on *vclass*, and felt it might be impossible to demonstrate mathematical concepts, show procedures and write mathematical symbols on the *vclass* as revealed in the following excerpts:

*Akos: It has helped to improve virtual communication and collaboration . . . I think the vclass has made me a more effective communicator. I will have to be more efficient in relaying information to the students. You have ample time to spend on the vclass interacting with the students.*

*Atua You'll be able to see those that are able to login . . . like checking attendance . . . [But] there is that inability to communicate effectively with the students online . . . it is very difficult [with] video conferencing.*

*Aliu: I was teaching ordinary differential equations [with] symbols . . . all these symbols were not found in Vclass.*

These responses reveal the opportunities and threats which come with the deployment of emerging technology in teaching mathematics. Indeed, in the fourth industrial revolution led by technology [12], digital communication, collaboration, and interaction skills are undoubtedly key skills needed for active instructional delivery and workplace interactions. However, acquiring these skills depends on one's exposure or experience.

### C. *Vclass* as E-assessment Platform

Regarding activities and resources for implementing e-assessment such as online quizzes, assignments and examinations, the lecturers shared their experiences in the interviews as follows.

*Atua: when you give a quiz which is objectives you don't have to worry. The thing [vclass] will do the arrangement for you, mark for you, then you download the spreadsheet.*

*Akos: And another exciting thing is . . . how to create a question bank . . . it was exciting to do those things.*

*Adua: I downloaded all . . . the soft copies . . . marked as hard copies . . . I was having problem with the screen marking.*

*Aliu: . . . not sure if the actual student answered the assignment.*

These responses illustrate the usefulness of the *vclass* in assisting lecturers to mark and store assessment results for future retrieval. Particularly, the development of a question bank was a new and exciting aspect expressed by the lecturers. There were, however, some frustrations as lecturers attempted to transfer the usual face-to-face assessment practices onto online assessment practices. While the frustrations might threaten the sustenance of *vclass*, research [2] suggests that they can also lead to new learning curve and opportunity for lecturers to devise novel ways to conduct valid and reliable e-assessment.

### D. *Vclass* as an Innovative Way of Supplementary Face-to-face Teaching

The interview responses revealed that the lecturers valued the use of the *vclass* as innovation to the face-to-face interactions despite systems errors as highlighted below.

*Akos: It is innovative way of teaching. . . [that] should not be abandoned.*

*Adua: . . . I think . . . this vclass . . . we can upload things for students to get access to it first hand before . . . [But] it was impossible for 100 students to be enrolled.*

*Atua: [Vclass] is a record keeper like a database.*

*Aliu: The shared screen was a terrible one . . . [the] screen doesn't work.*

The lecturers' responses suggest that *vclass* could serve as a database of students and lecturers' activities and interactions. The lecturers, however, lamented the video streaming errors with the BigBlueButton, system login errors and download/upload errors resulting from large enrolment, large videos, or mathematical symbols.

## 4.2. Mathematics Students' Experience in the Use of *Vclass*

Students' responses during the interviews are presented in subthemes as follows.

### A. *Vclass* as Positive Intervention in the Era of Covid-19

All ten students expressed the view that it was the right intervention by the university to have introduced the *vclass* in the era of Covid-19 as exemplified here:

*Sama: [I]t is something good . . . as we all know to help in terms of this crisis so that they can help finish our course outline on time.*

*Ssala: it was big intervention management took . . . myself it helped me to put into practice my ICT.*

Students' comments reflect their feeling that the *vclass* can be a potential platform for addressing the mathematics learning crisis.

### **B. *Vclass* as a Platform for Uploading and Downloading Study Materials**

The following excerpts show how three students responded to the issue of study materials.

*Ssala: . . . some of the lecturers upload a video in a form of teaching and then you will listen.*

*Sadu: they only put slides on the LMS, some courses you will only go and see slides on the LMS, no explanation.*

*Saku: Is not that interactive . . . sometimes they only put slides on the LMS . . . and that doesn't help.*

These comments reveal that students view the *vclass* as a platform where lecturers produce mathematical content in the form of video, audio and text and upload it for them to download and learn at their own pace and time. It also reveals that the materials presented to students were not quite interactive for self-study, and did not meet their learning needs.

### **C. *Vclass* as a Favourable and Useful Instructional Platform**

In terms of instructional delivery, students responded that the *vclass* was useful as illustrated in the following excerpts:

*Sadu: It helps in finishing the course outline on time . . . the number of weeks in a semester and the workload meeting face-to-face for 2 hours every week would not help. So the LMS has come to help . . . so much in exploring much in internet.*

*Satia . . . lecturers upload a video in . . . you will listen and . . . involve almost all your senses like your ears, your eyes, everything is very attentive just like how you do it in the lecture room . . . you are relaxed.*

*Ssala: the LMS was able to make lessons to go fast. We are able to complete most of the topics compared to the face to face.*

These comments illustrate that students view the *vclass* as comparable to face-to-face teaching and as an opportunity to explore the internet anytime and anywhere. Thus, through the *vclass*, students gained skills by taking the courses and conducted research online to develop their own learning.

### **D. *Vclass* as an E-assessment Platform**

In terms of assessment, students expressed views that reflect both the opportunities and weaknesses of using *vclass* for e-assessment, as exemplified in the following two excerpts.

*Sama: . . . the assignment and exams were marked by the LMS, especially the multiple-choice.*

*Ssule: we were not getting much feedback from the lecturers anyway, so if the LMS will also be improved in such a way that there can be some prompt feedback from the lecturers.*

Students' responses suggest that even though the *vclass* supports e-assessment and eases the workload of lecturers, they did not receive prompt feedback from their lecturers.

#### 4.3. Challenges Experienced by Lecturers and Students in Using *Vclass*

Word Cloud using INVIVO 12.0 software was used to categorise the data according to the most occurring challenges in terms of system functioning, course creation, lesson delivery, and assessment and support services experienced by both lecturers and students. The results are presented in Figures 2 and 3.

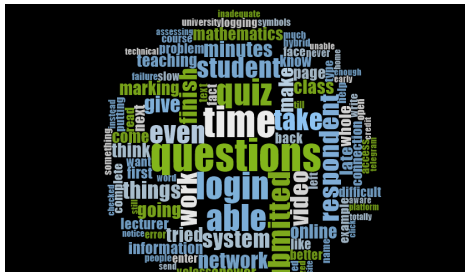


Fig. 2: Lecturers' most frequent challenges in vclass

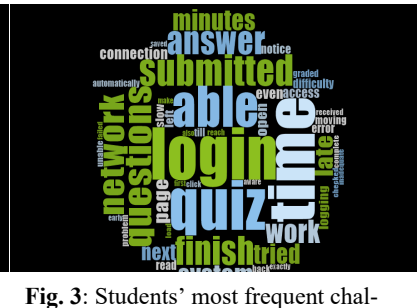


Fig. 3: Students' most frequent challenges in vclass

Figure 2 shows that the most frequent or pronounced challenge encountered by lecturers was *time* i.e. *time* to create course and questions bank, *time* for students to answer questions, and *time* to give marks online. This was followed by *questions* to set, and *login* to do quizzes and submit online. Issues concerning system network, answers and mathematics symbols were other frequently occurring challenges faced by lecturers in the use of the *vclass* (Figure 2). Also, Figure 3 shows that the most frequent or pronounced challenge encountered by students was *login*, followed by *time* and *quiz* submission on *vclass*. These issues were mentioned 42, 42 and 40 times by the students. These challenges demonstrate the level of students' frustrations and anxieties in the use of *vclass*.

## 5 Conclusion

The study shows that *vclass* experiences of lecturers and students can be summarised into strengths, weaknesses, opportunities and threats. The strengths were internal positive attributes of *vclass* that allowed users to operate efficiently to achieve their learning goals. The study found that the *vclass* platform was easy to create courses, deliver live video lessons using BigBlueButton, create question bank and e-assessment including system marking, quiz, assignment, chat, forums, etc. The weaknesses included aspects that affected lecturers' and students' effective use of the *vclass* platform. In this study, these were lack of quick feedback, low digital literacy levels, lack of mathematical

symbols, and inability to conduct practical lessons. The opportunities were experiences that could be leveraged to gain advantage in the use of the *vclass* in learning mathematics. These included improvement in the digital skillset of students, and the digital pedagogy of lecturers, transformation of e-assessment skills of lecturers, promotion of the reuse of existing courses, use of assessment data in research/decision making, and the adoption of a hybrid mode of mathematics instructions. The threats were activities that negatively impacted on the effective use of the *vclass*. In this study, these comprised assessment security, registration challenges, and login and network problems.

Based on the experiences shared by lecturers and students, the study concludes that there are more strengths and opportunities than weakness and threats when *vclass* is used for mathematics instructional delivery. Hence, the *vclass* should be encouraged and sustained.

## 6 Recommendations

The study recommends that the UEW should improve the bandwidth and connectivity, and include a Maths built-in app to facilitate effective online interaction among mathematics lecturers and their students. There is also the need for the university to organise training and professional development sessions for lecturers on the principles and theories of instructional design, course creation, digital pedagogy and e-assessment. Lecturers should be trained on how to use data in the *vclass* for research, SWOT analysis and decision-making regarding performance, assessment and online interactions. Students should also be provided with regular orientation and support services at departmental levels, to enable them to adjust to the new learning platform. Finally, the study recommends a hybrid mode of mathematics teaching and learning to enable both lecturers and students to make amends for the weaknesses and threats associated with the *vclass*.

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