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RESEARCH ARTICLE

EVALUATION OF THE FLIPPED CLASSROOM SET-UP FOR FACE-TO-FACE CLASSES OF THE DEPARTMENT OF INDUSTRIAL ENGINEERING, CTU-ARGAO, CEBU PHILIPPINES

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ABSTRACT

The COVID-19 pandemic has necessitated changes in higher education, leading to the adoption of more adaptable, effective, and student-centered educational methods. The flipped classroom, which involves moving information transmission online and utilizing face-to-face class time for active learning, has gained popularity in this context. This study evaluates the readiness of the flipped classroom set-up for face-to-face classes at the Department of Industrial Engineering, CTU-Argao, Cebu, Philippines, as a prevention measure against the spread of the COVID-19 virus. A modified survey questionnaire from the study of Youhasan, P. et la., (2021) was adopted and used in the study. The 20-item questionnaire assessed personal readiness, technological readiness, environmental readiness, pedagogical readiness and a checklist was used to evaluate classroom facilities. The analysis of the survey results was conducted using quantitative statistics. The study found that the flipped classroom model has a high possibility of being implemented based on respondents' positive perception of its technological readiness. Respondents expressed willingness and interest in engaging and developing their skills in this setup. However, concerns were identified in terms of environmental readiness, particularly with access to computers and high-speed internet. Pedagogical readiness was also observed, with respondents showing capability to adapt to sudden changes from online classes to flipped classroom setups. The study also highlighted compliance with health protocols in accordance with CHED-DOH Joint Memorandum Circular No. 2021-001. The paper suggests that flipped classrooms can be considered as an alternative or viable solution to the challenges posed by COVID-19, and provides guidance for implementation in an industrial engineering course.

KEYWORDS

Environmental, modern model teaching-learning, pedagogical, personal, technological

1. INTRODUCTION

Many changes took place in the areas of education, teaching methods, and strategy, which serve as a major challenge for teachers in today's technical and scientific age, particularly in this COVID-19 pandemic (Hrastinski, 2019). The coronavirus disease (COVID-19) had a worldwide impact on people's lives. Because of the health catastrophe caused by the pandemic, many schools and universities were forced to undergo an unexpected transition from traditional face-to-face studying to digital teaching and learning. This situation has affected teachers and students worldwide, from primary to secondary school (Kaden et al., 2020). Students face challenges such as a lack of access to academic resources and distractions in the home learning environment (Clabaugh et al., 2021) and may have experienced negative emotions as a result of the hurried switch to an unfamiliar learning situation.

Higher education institutions are attempting to provide greater flexibility and individualization, primarily through the use of new technologies and the implementation of e- learning designs. The majority of flexible learning initiatives focus on temporal and spatial flexibility in learning, which is now primarily realized through the use of new technologies and implemented in an e-learning environment (Andrade et al., 2019). Flipped classrooms, on the other hand, claims not only to enhance classroom learning, but also to redesign the learning environment to give learners more freedom (Smith and Hill, 2019).

Many universities have considered replacing some or all of their classroom instruction with an online learning environment, not only in the short term but also in the long term (Peter et al., 2020). However, universities will be able to offer and expand these learning formats with long- term success only if face to-face classroom time can be replaced with more flexible learning conditions without reducing student performance.

This study proposes a path for the CTU-Argao to continue teaching and learning during the COVID-19 pandemic through assessing the feasibility of flipped classroom set-up as this strategy provides a simple but dependable emergency means. This study evaluates the readiness of the flipped classroom set-up for face-to-face classes of the Department of Industrial Engineering, CTU-Argao, Cebu Philippines as prevention in the spread of Covid-19 virus.

2. RELATED LITERATURE

Despite the challenges posed by COVID-19, this epidemic has led in novel

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online teaching and learning solutions and an evaluation of pedagogical methodologies. The flipped classroom approach is a current emerging and popular instructional method in engineering education (Castedo et al., 2019). The flipped classroom paradigm is defined as the approach of investing activities outside the classroom to be conducted inside and vice versa. This means that activities performed by students outside of the classroom, such as homework and assignments, would be performed in class, while activities performed by professors inside the classroom, such as lectures, would be recorded and performed outside of the classroom (Akçayır and Akçayır, 2018). Research indicates that employers are now seeking engineers with soft skills such as critical thinking, problem-solving, lifelong learning, and others in addition to their technical skills, (Gerwel et al., 2018). Engineering education should provide several essential pieces of training for students to develop problem-solving skills and substantial technical knowledge so that they can handle real-world issues in the workforce (Mason et. al., 2013). The standards of the learning environment for students vary when the flipped classroom is adopted, and this needs to be understood (Boeve et al., 2017).

The application of flipped classroom in engineering education has been addressed in several of the reported studies in the literature (Al-Hammoud 2017; Manteufel et al., 2019; Shen et al., 2019; Wagner, 2019). A study addressed some of the issues of the flipped classroom, including the lack of additional examples in the lecture videos, the inability to ask questions and receive prompt responses when in-person. To solve some of the aforementioned problems, the author created an engaging online quiz customized to the requirements of the students. The experiment conducted by a recent study using the flipped classroom methodology in an introductory thermodynamics course did not turn out well (Manteufel et al., 2019). The students' refusal to prepare by reading the given materials and PowerPoints before entering the classroom was the primary cause of the flipped classroom model's failure in Manteufel's experiment. When previous research applied the flipped classroom concept in a Computer Integrated Manufacturing course, the author determined that the students had an "effective learning experience" because they were prepared prior to attending the classes (Wagner, 2019). Furthermore, an "iterative framework" to assist instructors in developing materials for the flipped classroom model in order to reduce the instructors' workload created by (Shen et al., 2019). The framework was implemented by the authors using one of the mechanical engineering courses. According to the study, students' learning performance outcomes in the targeted course improved.

3. Theoritical Framework

3.1 Technological Pedagogical Content Knowledge (TPACK) Framework

To further understand the student's perspective on the application of the flipped classroom model in industrial engineering courses, the TPACK (Technological, Pedagogical, and Content Knowledge) model was utilized in the study since the flipped classroom model integrates technology into the teaching and learning process. The TPACK framework, which was built on the concept of Shulman's PCK model, was developed by (Mishra and Koehler, 2006). It was used in the study to develop considerations when implementing flipped classrooms, improve students and teachers understanding of flipped classrooms, and successfully implement technology in flipped classrooms (Kusuma, 2020). Technology integration is one of the special elements of this pedagogy that teachers must consider. In a traditional classroom, technology integration may be an option. On the contrary, the flipped classroom is a pedagogy that highlights the technology that creates the benefit of a flexible environment (Yang, 2022). To successfully implement a flipped classroom model, students' and teachers' technological, personal, environmental, and pedagogical readiness are critical factors to consider.

3.2 Technological Readiness

As a preparation for creating a new method of blended learning, technological readiness is a must. Educational technology is a term that encompasses a wide range of media that deliver text, audio, images, animation, and streaming video, as well as technology applications and processes such as audio or video tape, satellite television, CD-ROM, and computer-based learning, as well as local intranets and extranets and web-based learning. Many e-learning processes are supported by information and communication technologies, which can be standalone or based on local networks or the Internet in networked learning. According to (Bandura, 1977), "perceived self- efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments ". Technology self-efficacy can thus be defined as a person's beliefs, judgments, or perceptions about his or her abilities to organize and execute the technology knowledge required to achieve effective instruction. According to research, technology self-efficacy predicts technology use in education (Backfisch et al., 2021). As a result, technological self-efficacy can be used as a personal assessment and predictor of technology use (Tekin and Gündeğer, 2021).

3.3 Personal Readiness

Flipped learning, in comparison with traditional teaching, enhanced students' learning interests and motivation as well as promoted their learning effectiveness (Lin et al., 2018). Investigating the students and teacher's personal readiness will make the process of adjusting to new teaching and learning methods easier. It is important to be aware of the personal readiness of both students and teachers, as it leads to improved learning and teaching outcomes and can increase productivity. Under personal readiness are ability and interest. Ability refers to the academic capability of a person, which can influence the rate at which a person can learn. This includes the personal view of a person on how their skills operate or work (Dweck, 2002). Interest refers to the topics, skills, and activities that awaken someone's curiosity, boost learning, and elicit effort (Dewey, 1913).

3.4 Environmental Readiness

In order to prevent the spread of COVID-19 in school settings, precautionary actions are necessary. Higher education institutions are operating in a complex environment that is influenced by greater access to distributed learning and new technology (Duderstadt, 2009). It is more important for educational institutions to evaluate the safety and needs of technology in the teaching-learning process. Environmental readiness is essential in creating a new method of teaching or learning as it can affect the engagement of students, their motivation to learn, and their assessment performance (Simpson and Richards, 2015).

3.5 Pedagogical Readiness

Teachers need to be more familiar with digital means and upgrade their pedagogical approach to a more technology-oriented and blended model (Karim and Mokhtar, 2021). Pedagogical readiness, as stated by (Bappa-Aliyu, 2012), specializes in the relationship between ICTs and modern coaching and gaining knowledge of practice. The idea of gaining knowledge online has delivered new possibilities for behavior and evaluation through the use of the virtual platform and adapting the constructivist technique through social interaction, discussion, collaboration, peer remarks, and more. (McCarthy, 2017) said that beneficial remarks from instructors create the rules for gaining knowledge of autonomy and an excessive fulfillment framework, which could enhance gaining knowledge of the improvement of instructors' online knowledge of pedagogical capabilities might be taken into consideration for consideration. An evaluative study on instructors' expert improvement programs to decide the merit, value, or really well-worth of online learning is likewise recommended. Lastly, this look describes exploring instructors' perspectives concerning their readiness to include online learning.

It is consequently appropriate for additional research to extend the study's subject matter to discover era-mediated approaches that concentrate on the college students' needs.

4. Methodology

The study was conducted in CTU-Argao Campus. The institution offered Bachelor of Science in Industrial Engineering. During Covid-19 pandemic, the "New Normal" instruction in the Philippines embraced online learning in which it made students' mathematics motivation and self-efficacy significantly decreased (Mamolo, 2022). Industrial engineering course demanded hands-on components and project-based tasks, which can be hampered by online classroom dynamics (Hoorani, 2022). Quantitative research design was used in this study. The study aimed of discovering how many students think, act or feel in a specific area of readiness: personal readiness, technological readiness, environmental readiness, and pedagogical readiness.

The study utilized an online survey questionnaire and disseminated through Facebook messenger. The modified questionnaire was adopted from the study of (Youhasan et al., 2021). The said instrument was composed of a 20-item questionnaire that assess the four areas such as personal readiness, technological readiness, environmental readiness, and pedagogical readiness of the respondents. The responses were graded using a four-point Likert scale, which the respondents can select one of four possible responses to a specific question or statement, ranging from 1 (Strongly Disagree) to 4 (Strongly Agree). A checklist was used to evaluate the readiness of the classroom facility in compliance to CHED-

DOH Joint Memorandum Circular No.2021-001. The 288 respondents were determined based on Slovin's formula. The analysis results were evaluated using quantitative statistics (percentages, mean, and frequencies). The responses will then be tallied in order to obtain the raw data, which will be treated accordingly using average weighted mean, percentage and frequencies.

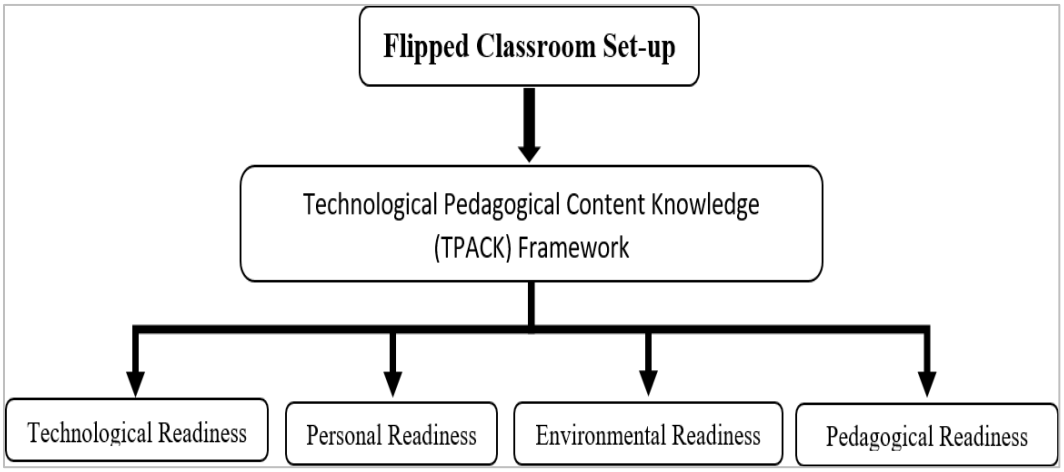

Figure 1: A Schematic of the Theoretical Background of the Study

5. Results

Based on the administered data, the following were the results of the study:

(i) Technological Readiness

The table below shows the total of students' perceptions is 3.20 (fairly positive perception), while the total of instructors' perceptions is 3.61 (very positive perception), with an overall mean of 3.41, which is interpreted as a very positive perception of technological readiness regarding the implementation of the flipped classroom. Both students and instructors were capable of using any instant messaging software (3.59) and has access to learning and teaching materials offline applications needed for the implementation of the flipped classroom (3.53). Respondents has a very positive perception that they can manage the use of media players (3.48) and has agreed that they can search for the information they need from online resources (3.35). The respondents have the convenience of using the paraphernalia of online classes like mobile phones, laptops, tablets, personal computers, and others (3.27). It was clearly presented that the current educational situation of CTU-Argao can adapt the proposed learning and teaching model, which is the flipped classroom setup.

(ii) Personal Readiness

Both respondents had shown that they had a positive perception towards the adaptation of the flipped classroom in their learning and teaching styles. Respondents expressed their willingness to receive hands-on training in a flipped classroom (3.40). They are also interested in engaging in flipped learning (3.25) and were interested in achieving their learning and teaching outcomes through flipped learning and teaching (3.19). And lastly, the students have a fairly positive perception of having fun while taking exams or quizzes online, while instructors have a very positive perception, which means that they are interested in and willing to conduct activities inside the classroom as well as through online or Google Forms kinds of exams or quizzes. Overall, the total mean had a fairly positive perception of making online quizzes as a classroom activity (3.17). With the attitudes presented, the classroom set-up had a high chance of being implemented successfully.

Table 1: Students' and Instructors' Perception on Technological Readinessn = 288

TECHNOLOGICAL READINESS						
INDICATORS	**STUDENTS' PERCEPTION**		**INSTRUCTORS' PERCEPTION**		**TOTAL**	
	$\bar{x}$	**Interpretation**	$\bar{x}$	**Interpretation**	$\bar{x}$	**Interpretation**
1. I can use document viewing software (i.e., Adobe Reader) to read materials.	3.08	Fairly positive perception	3.33	Very positive perception	3.21	Fairly positive perception
2. I can use instant messaging software (i.e., Viber, WhatsApp, Facebook, Skype and Twitter) to communicate with people.	3.29	Very positive perception	3.89	Very positive perception	3.59	Very positive perception
3. I can download files from the internet.	3.29	Very positive perception	3.78	Very positive perception	3.53	Very positive perception
4. I can operate online media players (i.e., VLC Media Player) to watch/listen/make multimedia materials.	3.30	Very positive perception	3.67	Very positive perception	3.48	Very positive perception
5. I can search for the information that I need from online resources.	3.14	Fairly positive perception	3.56	Very positive perception	3.35	Very positive perception
6. It is convenient for me to use a computer and/or mobile phone in my learning/teaching.	3.10	Fairly positive perception	3.44	Very positive perception	3.27	Very positive perception
TOTAL	**3.20**	**Fairly positive perception**	**3.61**	**Very positive perception**	**3.41**	**Very positive perception**

Table 2: Students' and Instructors' Perception on Personal Readiness n = 288						
PERSONAL READINESS						
INDICATORS	**STUDENTS' PERCEPTION**		**INSTRUCTORS' PERCEPTION**		**TOTAL**	
	$\bar{x}$	**Interpretation**	$\bar{x}$	**Interpretation**	$\bar{x}$	**Interpretation**
1. I am willing to engage in flipped learning/teaching.	3.06	Fairly positive perception	3.44	Very positive perception	3.25	Very positive perception
2. I am willing to make the time available for flipped learning/teaching.	3.05	Fairly positive perception	3.44	Very positive perception	3.25	Very positive perception
3. I am interested in achieving my learning/teaching outcome through flipped learning/teaching.	3.04	Fairly positive perception	3.33	Very positive perception	3.19	Fairly positive perception
4. I need hands-on training for engaging in a flipped classroom.	3.24	Fairly positive perception	3.56	Very positive perception	3.40	Very positive perception
5. I am interested in playing/making online quizzes as a classroom activity.	3.01	Fairly positive perception	3.33	Very positive perception	3.17	Fairly positive perception
TOTAL	**3.08**	**Fairly positive perception**	**3.42**	**Very positive perception**	**3.25**	**Very positive perception**

CTU-Argao encourages students to learn with technology (3.14). According to Duderstat (2009), education institutions operate in a complicated environment that is influenced by increased access to distributed learning and new technology; hence, computer labs are also vital in the teaching and learning process (3.15). Yet, in order for the deployment of the flexible classroom to be a complete success, educational institutions must first assess the safety and needs of technology. CTU-Argao provides technical assistance to e-learners (3.02), but there were issues to consider when adopting the flipped classroom setup, such as the university's inconsistent internet connection (2.32) and a lack of necessary resources (2.88) for flipped learning in order to create a new manner of teaching and learning.

In this study, the development of instructors' online learning pedagogical abilities has been considered. Online platforms can be used by instructors or students who prefer student- teacher interaction (4.08). Evaluating instructors' professional development platforms to determine the usefulness, value, or truly good worth of online learning platforms for the success of the implementation of the flipped classroom It would be convenient for them if an online platform could be utilized to interact with (3.83). Respondents preferred to have a student-centered classroom learning and teaching process such as role-play, problem-based learning, debates, and quizzes rather than learning and teaching from a traditional lecture (3. 71). These are the teacher's and students' thoughts on their readiness to incorporate online learning. As a result, it is appropriate for more research to broaden the research topic in order to uncover technology-mediated learning approaches that focus on the demands of the students.

Table 3: Students' and Instructors' Perception on Environmental Readinessn = 288						
ENVIRONMENTAL READINESS						
INDICATORS	**STUDENTS' PERCEPTION**		**INSTRUCTORS' PERCEPTION**		**TOTAL**	
	$\bar{x}$	**Interpretation**	$\bar{x}$	**Interpretation**	$\bar{x}$	**Interpretation**
1. I have access to the internet connection in the University (e.g. WIFI).	2.32	Fairly negative perception	3.22	Fairly positive perception	2.77	Fairly positive perception
2. My university provides the necessary resources for flipped learning.	2.88	Fairly positive perception	2.89	Fairly positive perception	2.88	Fairly positive perception
3. My university promotes technology-enhanced learning practices among students.	3.14	Fairly positive perception	3.22	Fairly positive perception	3.18	Fairly positive perception
4. Technical help is available for e-learners in the university.	3.02	Fairly positive perception	2.78	Fairly positive perception	2.90	Fairly positive perception
5. Computer labs in my institutions are the most important assets for using flipped learning.	3.15	Fairly positive perception	2.89	Fairly positive perception	3.02	Fairly positive perception
TOTAL	**2.90**	**Fairly positive perception**	**3.00**	**Fairly positive perception**	**2.95**	**Fairly positive perception**

Table 4: Students' and Instructors' Perception on Pedagogical Readiness n = 288						
PEDAGOGICAL READINESS						
INDICATORS	**STUDENTS' PERCEPTION**		**INSTRUCTORS' PERCEPTION**		**TOTAL**	
	Mean	**Interpretation**	**Mean**	**Interpretation**	**Mean**	**Interpretation**
1. I prefer a student-teacher interaction at a platform could be used to interact with instructors/students.	4.08	Very positive perception	3.44	Very positive perception	3.76	Very positive perception
2. It would be convenient if an online platform could be used to interact with instructors/students.	3.83	Very positive perception	3.00	Fairly positive perception	3.42	Very positive perception
3. I prefer a student-centered classroom learning/teaching process (such as role-play, problem-based learning, debates and quizzes) rather than learning/teaching from a traditional lecture.	3.71	Very positive perception	3.56	Very positive perception	3.63	Very positive perception
TOTAL	**3.86**	**Very positive perception**	**3.33**	**Very positive perception**	**3.60**	**Very positive perception**

Table 5: Overall Readiness of CTU-Argao Regarding to the Implementation of Flipped Classroom		
INDICATORS	$\bar{x}$	**INTERPRETATION**
Technological Readiness	3.41	Very positive perception
Personal Readiness	3.25	Very positive perception
Environmental Readiness	2.95	Fairly positive perception
Pedagogical Readiness	3.60	Very positive perception
Total	**3.30**	**Very positive perception**

Table 6: Parameters Used in Interpretation of Data	
SCALE	**INTERPRETATION**
1 (1.00 – 1.75)	Strongly Disagree (Very negative perception)
2 (1.76 – 2.49)	Disagree (Fairly negative perception)
3 (2.50 – 3.24)	Agree (Fairly positive perception)
4 (3.25 – 4.00)	Strongly Agree (Very positive perception)

Table 7: Evaluation of Facilities Inside the Campus		
AREAS OF EVALUATION	**COMPLIANCE (no. of items)**	
	Complied	**Not Complied**
A. Classrooms	6	-
B. Laboratories	6	-
C. Eating/Dining Area/Communal Areas	7	-
D. Library	7	-
E. Isolation Room for Symptomatic Individuals	9	-
F. Comfort Rooms	5	2
G. Stairways/Corridors	3	1
H. Entry/Exit Gates	8	-
I. Foot Traffic	3	-

In compliance to CHED-DOH Joint Memorandum Circular No. 2021-001, the CTU-Argao Industrial Engineering Department shows that the facilities such as classrooms, laboratories, dining areas, library, isolation room, comfort rooms, stairways, gates and foot traffic are already following the health protocols which were marked complied in the evaluation form by the department head. It appears that the safety of both students and teachers were prioritized for the face-to-face interaction inside flipped classroom model.

The findings show a high level of viability that the current classroom set-up in the CTU-Argao Industrial Engineering department is linked with the flipped classroom in preparation for face-to- face classes. Therefore, the said set-up can be used as a new set-up for learning and teaching.

On the basis of the findings, little adjustments to the environmental readiness of the school will be recommended as they will improve learner engagement, teacher-student interaction, and promote self-learning.

6. Discussion

This study evaluated the readiness of the flipped classroom set-up for face-to-face classes at the Department of Industrial Engineering, CTU-Argao, Cebu, Philippines, as a prevention measure against the spread of the COVID-19 virus. The overall findings of the study confirmed that encouraging flipped classroom practices in the aforementioned context is feasible. The students polled expressed their personal and technological preferences, as well as their readiness to enroll in a flipped classroom program. This could be due to students' preference for technology-enhanced, learner-centered education. The study cohort could undoubtedly be classified as a distinct and truly digital-native generation.

As a result, the flipped classroom would be an effective pedagogical option for connecting with the new normal and increasing attention span. This study added to the evidence that undergraduate students (in engineering courses) have a strong personal and technological preference for and readiness for flipped classroom programs. In a survey of students' perspectives on current teaching and learning practices, they expressed a desire for more application of classroom learning. They also requested an interactive and interesting teaching method. The flipped classroom is said to be one of the most effective pedagogical methods for reducing boredom. Students value being exposed to student-centered learning approaches, according to our findings. Because evidence suggests that flipped classroom pedagogy emphasizes student-centric teaching approaches, this could be a gateway to it.

Nonetheless, pre-class preparation is viewed as a major barrier to flipped classroom implementation because of the internet's connectivity. It is critical that teachers approach and motivate students who are not participating in pre-class activities. One approach is to connect pre- class activities to subsequent assessments. The majority of engineering students in this study believed that the existing equipped learning environment at Cebu Technological University would aid in the successful implementation of the flipped classroom. These findings have several implications for teachers and university administrators. According to the teachers, students appear to be less interested in passive learning inside the classroom. It is critical to identify a meaningful mechanism for motivating students to complete pre-class activities. Students demonstrated their readiness and interest in participating in a flipped classroom program to university administrators. While students are essential stakeholders in the teaching-learning process, it would be more comprehensive to include the perspectives of teachers and university administrators in future research.

This study advances our theoretical knowledge of the flipped classroom methodology and its effects. Our findings may also be applied to the creation of fresh courses and innovative learning environments that aim to boost students' engagement and performance. As previous study established, additional study is required to determine the situations in which the flipped learning model functions best as well as the best ways to deploy its components (Brewer and Movahedazarhouligh, 2018). It might support educators as they switch from traditional to flipped classrooms. These results demonstrate the potential educational value of the suggested strategy. Since effective learning and assessment activities have a big impact on learning accomplishment in a flipped classroom, the suggested system used in the proposed approach gives instructors and students a powerful learning and diagnosis tool (Wang, T. 2017).

7. Conclusion

Given the urgency of the situation, educators must find ways to keep their activities going until normalcy returns. As a result, this study proposed the modified flipped classroom as an alternative and viable solution. This suggestion was based on previous research that found a wide range of positive effects when flipped classrooms were implemented correctly (Castedo et al., 2019; Cheng et al., 2018). Because of its numerous benefits, ranging from students' liking it to instant support from instructors through active learning, the flipped classroom is regarded as an ideal pedagogical model in which both purely theoretical and practical-based subjects can be successfully taught. However, it has been observed that, in addition to the proponents of the flipped classroom, there is

another group of students who are not enthusiastic about it. This is one of the most significant challenges to this pedagogical approach. Finally, it was suggested that additional research be conducted in order to improve student acceptance and motivate them to prepare as thoroughly as possible prior to class time. in relation to gathering teachers' and students' experiences with this platform (modified flipped classroom) and providing additional support for its implementation. This proposed study could provide more empirical evidence on internet connectivity and speed, problems encountered by teachers and students, and so on.

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