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Section -A-

Sciences de la Nature et de la Vie Sciences techniques

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The impacts of Zoom technologies with flipped classroom on students' academic performance, cognitive load and satisfaction

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Informations	Abstract
Mots clés : Flipped classroom Google application Covid-19 Zoom cognitive load motivation *Correspondence : mahnane_lamia@yahoo.fr	Flipped classroom, a form of student-centred instruction, promotes interaction and discussion. In contrast, traditional teacher-centred teaching activities make it difficult to control the learning situation in the classroom and prevent students expressing their ideas during COVID-19. Flipped classroom with zoom meeting can allowing students to instantly express their ideas or respond to the teacher. In the class, Zoom technologies were used to discuss and clarify ambiguous ideas in the topic, present the model answers for the tasks and assessment. Teachers can provide interactive activities and can more deeply understand students' learning processes. Therefore, this research used a comparative quasi-experimental design to investigate the impacts of flipped classroom with ZOOM technologies on students' cognitive load and motivation.

1. Introduction

Covid- 19 virus, which arose in China in December 2019 and has prevailed all over the world since then, has not only affected the healthcare field but also the educational field. In order to decelerate infection speed and spread of Covid-19 virus, to reduce the deaths that may occur, and to gain time for treatment studies, face to face education was suspended in many countries around the world, or hybrid educational models in which face-to-face education and distance education were carried out together began to be used [24]. In this context, it becomes more and more substantial to apply most appropriately face-to-face training and online learning opportunities together through different models such as flipped classroom model [1]. Flipped classroom model allows students to practice and collaborate more in the classroom, and it eliminates the "knowledge transfer" role of the teacher in traditional education by replacing the place and the time of lecture with homework [25]. With this model, since students learn the subject at home more time is allocated for individual and group studies, problem solving activities, and exercises in the classroom [2]. Further, conducted studies showed that when the students took part in their learning processes, not only their success and learning performances increased but also their

interests in peer learning processes [3] [4] [5]. [2] stated that with flipped classroom applications, students managed to spare more time for classroom activities and practices, and therefore an environment, necessary for students to speculate and examine, could be developed. In this context, the purpose of this research is to investigate whether using zoom technologies with a flipped classroom, could solve the teaching problems encountered during COVID19 and result in students' improved lower cognitive load and higher motivation by using a quasi-experimental method.

The following hypotheses guided our analysis and are postulated in this study:

H1: The cognitive load of students who learn with Zoom technologies and flipped classroom will be higher. H2: Students will be more motivated with the class when they learn with a Zoom technologies and flipped classroom.

The rest of this paper is organized as follows:

In Section 2, we present the basic concept of the flipped classroom. Section 3 is devoted the design of the proposed flipped classroom during Covid 19. In Section 4 we present the main characteristics defining the teaching experience that was carried out, describing in detail the procedure followed, the development of the measurement scale, and the method used to test the scale empirically. The

analysis and results obtained are described in Section 5. Finally, Section 6 draws conclusions and outlines future work.

2. Background

Flipped classroom is described as devoting more time for material usage in classroom by moving lecturing process out of classroom through videos, that is, the shifting between in-class training and homework [6] [7]. According to [8], flipped classroom system means to take the teaching, in which students are inactive, out of classroom through videos and to spend classroom hours with a learning process in which students are active. Similarly, [9] regarded flipped classroom as performing of a narrative education out-of-class and performing of the activities in classroom under the guidance of the teacher. On the other hand, [10] described it to be a perspective in which lecturing takes place out of classroom via videos or other resources in the light of a notion that the learning responsibility belongs to learners and active learning is carried out through classroom activities. The flipped classroom model enables students to learn without time and place limitations. In addition, it provides the opportunity to get ready for the activities to be done in the classroom by building their own knowledge outside the school. It is also aimed to eliminate note-taking monotony of the student in classroom and to get full efficiency from teachers in applications [11]. The flipped classroom model allows students to do more problem solving activities individually or with a group on subjects that they explore on their own in a classroom setting. Moreover, it allows concentrating on issues that many students face in the self-learning process, and gives opportunity to a teacher to give one-on-one attention to each learner [2]. The advantages of flipped classroom model for both teachers and learners can be sorted as follows;

- ✓ It enables students to attend the lessons even if they could not go to school because of various reasons such as social occasions or illness [6][12][13].
- ✓ It eliminates unnecessary time consumption for the subjects that students can learn easily on their own and instead of this, they can repeat the subjects that they hardly learn as many times as they need [14][15].
- ✓ It provides students with an opportunity to take responsibility and to gain self-knowledge. It also enables students to gain a skill through which they can apply

knowledge that they learned to real life conditions [14][16] [13].

- ✓ Independent of the place and time, it helps students to learn in accordance with their individual learning pace during the non-class period [6][17] [18].

- ✓ Flipped classroom model, based on constructivist learning approach, increases students' participation and interests to the course by means of student-centred learning [29] [30] [16].

- ✓ It facilitates classroom management, as it offers one to one or small group study opportunities to teachers [6].

- ✓ It contributes to develop and efficient and creative time management in classroom and to increase communication between teacher- student and student- student [6][16][30].

- ✓ It helps teachers to do more activities instead of teaching something in classroom and therefore they can focus on students' learning processes [19].

- ✓ By offering learning experience, peer learning and teacher guidance, it makes possible to run active learning and individual learning together [17].

- ✓ It leads students to present their knowledge and skills during the activities conducted in classroom [20].

- ✓ Students do their homework in the classroom so that teachers can easily recognize students' learning difficulties and their learning styles [16].

There are also some disadvantages of flipped classroom model besides its advantages. One of its common disadvantages may be regarded as the lack of technologic devices that are need for its application and technologic faults [21] [22]. Another disadvantage of this model is to give extra responsibility to the students [23]. This disadvantage shows itself in the possible inconsistency between students' learning habits and learning style of flipped classroom embedded technology. That, in contrast to those prefers to keep their own learning under control; other students may need extra assistance as they cannot manage their own time and studies [23]. To sum up, when the previous studies were investigated, it could be understood that its advantages predominated over its disadvantages.

3. Proposed flipped classroom

The main working strategy of flipped classroom is organizing three activities one after one, as shown in figure 1.

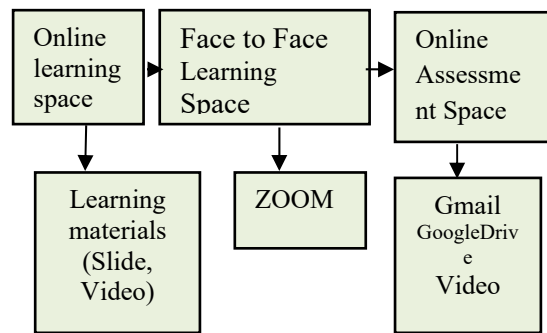


Figure 1: Proposed flipped classroom during Covid 19

- Teachers should share (upload) lecture materials to the students before organizing face-to-face class. Students will go through the lecture materials to understand the contents. During this time, students should identify their difficulties (content/topic that may not be clear to them) which could be asked to teachers during face-to-face class.
- During face-to-face class, teachers make themselves available to receive questions from students. Students' confusion (this confusion/ may arise during first stage that is in individual learning) will be clarified at face-to-face teaching. The teacher will receive students' questions until all students understood the lecture.

3.1. Online learning space

The aim of organizing an online platform is to provide learning spaces to individual and group students for achieving better learning outcomes via flipped classroom. Initially, the flipped classroom technique needs an online platform; By using online platform, different student-centered activities could be arranged. This platform facilitates teachers uploading their class lectures, and other required learning materials that should be prepared by the teachers following the course contents (curriculum), as shown in figure 2.

Chapitre 6 : Les polynômes

Cours
Questions-Réponses

Chapitre 7 : Les chaînes de caractères

Cours
TPs
Ex1.2.3
CompteTPs
TPsvidéo
Questions-Réponses

Les applications

TP7

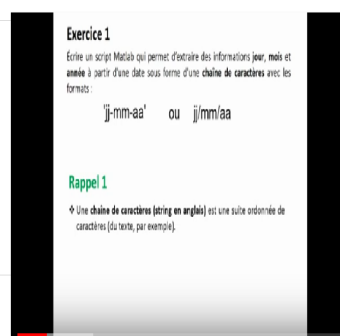


Figure 2: Learning material

3.2. Face to face learning space

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

- Teachers sign in Zoom platform for online classes;
- Teachers will invite all students to the Zoom classroom by using group Gmail from Zoom;
- Since students are aware of the online class time, within few seconds, students accepted invitation and join to the online session. Initially, teachers invite all students to ask questions (the questions should come from the lecture which sent to students two days before), and thereafter, teachers clarify issues (questions) raised by the students.
- The session (class) is ended when there are no more questions.
- Teachers may request students to provide few suggestions on how to improve next session. Lastly, teachers should provide information (instruction) to students on what will be sent for the next class.

The aim of including face-to-face classes is to clarify the issues (topics) which students may not understand at their own individual learning and apply the learned knowledge (online space). Teachers will organize regular classes at a face-to-face context with the intention of not conducting regular teaching (lecture presentation) but rather offering students the opportunity to ask questions and seek clarifications regarding the uploaded contents. Therefore, the teachers' main task is to clarify students' understanding by solving students' questions. This session is highly interactive between teachers and students to enhance students' understanding about the topic (lecture materials which teachers uploaded to the students at first stage). In the case of more practical subjects, the teacher assists students to correctly apply their new knowledge through various exercises and practical activities.

3.3. Online assessment space

To assess the learner it is necessary to use additional tools:

- Gmail Group

The main aim of creating this Gmail group is to organize communication with all students. Teachers will create a common Gmail Group including all students email address on it. It's could send any information to all students by sending one email. All students could communicate to the teachers after receiving email from the teachers.

- *Google drive*

The main aim of using Google Drive is for sharing assessment materials to teachers. Students upload assessment materials and videos for clarifying the ideas using group Gmail. Teachers will be able to access these materials and save these at their computer, as shown in figure 3.

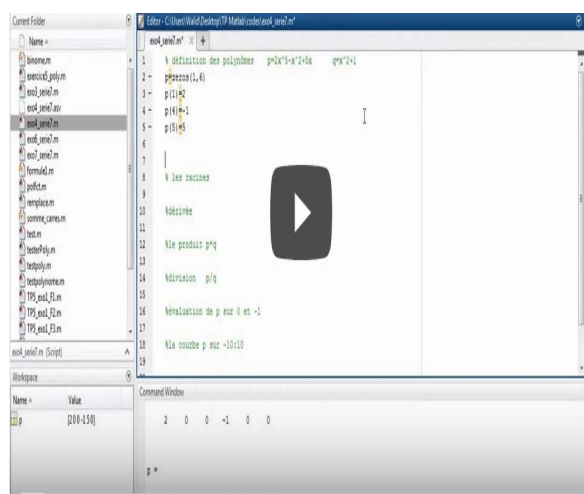


Figure 3: Student's feedback

4. Methodology

4.1 Participants

The teaching experience presented in this paper was conducted at the Faculty of Sciences in the University of Annaba (Algeria). The participants were 56 students (first Year LICENCE) enrolled in the Matlab course. This module consists of 30 teaching hours during the 15 weeks of the course. During this time, seven topics related to the module were dealt with as well as an introductory topic zero which was devoted to familiarizing the students with the Flipped Classroom method and with the necessary Information they would need to appropriately follow the course.

4.2 Research tools

The tools for assessment in this study included the questionnaire for measuring the students' learning motivation and cognitive load.

The Course Interest Survey (CIS) was to measure students' motivational reactions to the classroom instruction based on ARCS motivation model [26].

The CIS is considered a valid and reliable instrument with a documented reliability coefficient of 0.95 and four factors reliability (Cronbach's $\alpha = 0.80, 0.82, 0.79, 0.84$ for attention, relevance, confidence, and satisfaction, respectively) [27]. The questionnaire of cognitive load [28], it was consisted of two factors: mental load and mental effort.

5. Results

In this study, the collected data was examined by descriptive statistics to explore the group numbers, means and standard deviations. The paired-sample t-test was conducted on the learning motivation and cognitive load. In addition, learning motivation and cognitive load were analyzed.

5.1 Analysis of learning motivation

Table 3 shows the results of the CIS motivational questionnaires conducted before the intervention and after the intervention of the course. Means and standard deviation are provided for dependent variables attention, relevance, confidence, and satisfaction

Variable	Test	N	Mean	SD	T
Attention	Pre-questionnaire	56	3.21	.61	-7.01*
	Post-questionnaire	56	3.85	.48	
Relevance	Pre-questionnaire	56	3.87	.59	-3.99*
	Post-questionnaire	56	4.03	.50	
Confidence	Pre-questionnaire	56	3.73	.51	-5.90*
	Post-questionnaire	56	4.07	.52	
Satisfaction	Pre-questionnaire	56	3.42	.66	-6.15*
	Post-questionnaire	56	4.05	.69	

Table 3: t-Test result of the motivation

* $p < .05$

A paired-sample t-test was conducted to compare motivation to determine the effect of our model on the motivation of students. The results of a paired-sample t-test of CIS motivational questionnaires carried out afterwards are presented in Table 3. As shown in Table 3, the results of the paired-sample t-test indicated a significant difference between the pre-questionnaire and post-questionnaire for attention ($p < .05, t = -7.01$), relevance ($p < .05, t$

=-3.99), confidence ($p < .05$, $t = -5.90$), and satisfaction ($p < .05$, $t = -6.15$).

The results of the paired-sample t-test revealed that there was a statistically significant increase in the motivation of students.

5.2 Analysis of cognitive load

The study also compares the two aspects of cognitive load: mental load and mental effort, as shown in Table 4.

Table 4: t-Test result of the cognitive load dimensions

Variable	Test	N	Mean	SD	T
Mental load	Pre-questionnaire	56	3.46	.84	.34*
	Post-questionnaire	56	2.71	.77	
Mental effort	Pre-questionnaire	56	3.54	.81	-7.31*
	Post-questionnaire	56	2.61	.78	

* $p < .05$

For the mental load dimension, the means and standard deviations were 3.46 and .84 for the pre-questionnaire, and 2.71 and .77 for the post-questionnaire. The paired-sample t-test result shows that the mental load before intervention is significantly higher ($t = -5.34$, $p < .05$). On the other hand, for mental effort, the means and standard deviations were 3.54 and .81 for the pre-questionnaire, and 2.61 and .78 for the post-questionnaire. The paired-sample t-test result shows significant difference between the mental effort ratings ($t = -7.31$, $p < .05$).

The way of structuring and presenting the learning resource or the strategy adopted for guiding the students to learn have positive impact on the reduction of cognitive load [28]. Flipped classroom reduces the cognitive load by providing a visualized way of helping students organize their knowledge.

6. Conclusion

The study findings show that flipped classroom provides a meaningful improvement in the motivation of students. Under COVID-19 conditions, students are dedicated and inspired to their studies and they accept flipped teaching classroom. Flipped teaching classroom helps a large part of the students, because it is a fresh but happy experience for them. Via flipped training, they seem pleased to learn. When they study and take part in lectures via flipped teaching they express their comfort. According to them, teachers are easily available, they can ask questions through Facebook or zoom and they are answered on the spot by the instructor when online courses are performed or in leisure time afterwards. In addition, they can manage a certain amount of time for the online class in collaboration with their teacher and other colleagues, which is convenient for them. To end all this, it can't be an exaggeration to suggest that flipped teaching can make students feel relaxed, happy and confident, and eliminate anxiety and frustration.

Similarly, on the other hand, it has certain drawbacks as well. Not all pupils are professionals in the use of technology. An introduction and orientation with regard to the use of technology can be given to students. But over time these weaknesses can be resolved.

Flipped classroom offer an excellent opportunity for individuals to extend their educational opportunities and stay competitive in the ever-demanding field of education. Students of self-motivation, independence and responsibility must be students who access higher education through online courses. Understanding their learning style and skills allows students to determine more easily if online studying is acceptable for them. Teachers and course designers will also benefit from understanding the dimensions of a course that increases student awareness and participation. Communication in terms of encouraging feedback, positive feedback and instant input from teachers to learners is a key aspect of flipped classroom. Clear instructions and a readily accessible course are also components of a well-structured course. Overall, flipped teaching allow learning to take place in an atmosphere that is not limited to space or time; flipped classroom has the potential to reduce barriers generated by poverty, location, disability, as well as other factors.

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