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Effectiveness of Online Learning When Implementing Collaborative Online Learning In Flipped Classroom

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Abstract. The COVID 19 pandemic has forced schools, Universities to deliver courses in online learning environments. Finding an effective online learning model is crucial for online teachers to design, develop, and deliver an online course. This research has been conducted to analyze the online learning activities through using collaborative online learning in the flipped classroom for the students at the college level. Data have been gathered through an online questionnaire and it was sent to 300 first-year students in the department of electronic and electrical engineering attending physics courses at Cao Thang Technical College. Cronbach's Alpha is applied to evaluate the reliability and internal consistency of the associated factors. The exploratory factor analysis is performed to extract the variables and measure the factor loading in this study. Nine factors have been found to evaluate the effectiveness of collaborative online learning with flipped classroom, including goal and learning outcome (GLO), assessment strategy (AS), learning task (LT), course content (CC), learning resource materials (LRM), collaborative online learning (COL), types of interactions (ToI), types of presence (ToP), problem-solving task in post-class (PST-PC). The relationship between the dependent variable and independent variables is determined by using the linear regression model. The results show that nine independent variables were used in the study viz. GLO, AS, LT, CC, LRM, COL, ToI, ToP, and PST-PC positively impact students' satisfaction and further students' satisfaction positively impact the effectiveness of online learning (EOL).

Keywords. collaborative online learning, flipped classroom, teaching presence, social and cognitive presence

1. Introduction

The COVID 19 pandemic obliged schools, Universities to deliver courses in online learning environments. However, the online learning model is still similar to the traditional classroom, students passively receive information during lectures. This online teaching model has disengaged students in the learning process. As a result, students feel impersonal, isolated, and non-interactive online learning, they are bored with online courses. However, there has been little research on a framework for online teaching and learning model in which students are the heart of the learning process. Therefore, finding the effectiveness of online learning is important for a teacher to motivate and engage students in the learning process.

Flipped classroom (FC) is a learner-centered approach, it encourages students to exploit content knowledge to reserve more time for learning activities in-class. This approach permits learners to improve higher-order thinking skills (Öztürk & Çakıroğlu, 2021). Additionally, FC

involves the students in learning activities, developing 21st-century skills (Prevalla & Uzunboylu, 2019). We found that FC is the heart of the socio-constructivist theory in which students construct knowledge through interacting with their peers, teacher, and content in the online learning environment. Besides, Vygotsky (1978) stated that students do not learn in isolation, they learn through collaborative work. We assume that using collaborative online learning when implementing the FC enhances the effectiveness of the learning outcome. Thus, this research aims at designing, developing, delivering, and evaluating an online course through combining collaborative learning and FC by examining students' perceptions of this online learning model.

2. Literature review

Online learning

In a virtual learning environment, synchronous and asynchronous learning can be effectuated depending on the scenario learning (Garrison et al., 1999). Synchronous learning happens in real-time for the teacher and learners whereas asynchronous learning requires students to complete work each week on their schedule, within a certain timeframe (Andrade, 2015). To optimize learning experiences for students who take part in online learning environments, Yamagata-Lynch (2014) encourage teachers to use these two types of learning. Teachers use synchronous or asynchronous depending on the learning scenario.

Learning theory

Learning theories can help teachers analyze students' learning needs, design, develop, and implement courses in an online learning environment. Three learning modes, cognitivism, constructivism, and socio-constructivism, are used when instructional design. First, the cognitivist theory concern with acquiring, processing, organizing, and retrieving information by the mind (Clark, 2018). Second, the constructivist theory mentioned that students actively build knowledge based on prior knowledge and experience. Thus, knowledge cannot be simply transferred from teacher to learner, but must be constructed by the learner (Piaget, 1973). Third, the socio-constructivist mentioned that students build knowledge through interaction with their teachers and peers. Collaborative learning is the heart of the learning process (Vygotsky, 1978). Vygotsky's concept of the "zone of proximal development" is fundamental to designing, organizing teaching, and learning.

Online pedagogy model

An online pedagogy is an approach that facilitates the delivery of an online course in an online learning environment using information and communication technology. An online pedagogy insists learner-centered approach and implements active learning activities (Grieve et al., 2017; O'Neil & Fisher, 2008). Pelz (2010) mentioned that online learner has to spend engaged with the content in the learning process. The online teacher uses technology to enhance the course content. The teacher plays a role as a guide for students toward the learning goal. To enhance interaction between learners and tasks, the online teacher is required to use teaching strategies and techniques (Nadiyah et al., 2014). To design, develop, and deliver an online pedagogy, an instructional design course is effectuated. In terms of effective course design, the backward design is used (McTighe & Thomas, 2003). In the backward design course, the course learning outcome is required to clearly state before delivering the course. Thus, the learning outcomes statement should be referred to Bloom's taxonomy (Bloom, 1956). Based on the learning outcome statement, the assessment strategy is planned (Khan, 2012). After determining the assessment strategy, the instructional strategies and learning activities are implemented.

During the online course, types of presence are effectuated, including cognitive presence, social presence, teaching presence (Garrison et al., 1999; Anderson et al., 2001). Relating to cognitive presence, the learning process is activated when students are involved in solving real-world problems, they apply the prior knowledge as a foundation to construct a new one. The new knowledge is applied, integrated into the learner's world (Merrill, 2002). Concerning social presence, the teacher builds positive rapport by using open, friendly communication. With regard to teaching presence, Cormier & Siemens (2010) stated that teacher keeps students motivated and engaged in the online learning. Anderson et al., (2001) mentioned that teaching presence concern with the design, facilitation, and direction of cognitive and social processes to effectuate the desired learning outcomes.

Collaborative online learning

Collaborative learning is a modality for the learner to coordinate their independent work to attain a shared goal (Falcione et al., 2019). Collaborative online learning is a learning model in which students are assigned to work in a group to build knowledge. Collaborative online learning promotes active interaction with other members of the group, each student is responsible to the group, and their work is positively interdependent (Yamarik, 2007). In a collaborative online learning environment, learning tasks were structured to promote the student-student interaction, student-teacher interaction, student-content interaction (Moallem, 2003). Collaborative learning has been proved to enhance students' learning. In collaborative online learning, the student groups team is composed of five at most. Each group is given a task to execute, each student studies, thinks and shares ideas among members (Dillenbourg, 1999). Collaborative online learning requires some online collaborative tools such as Google Docs for co-constructing knowledge in group project work.

Flipped classroom

The teacher provides students with instructional videos, quiz; students explore the knowledge before going to class. Make use of class time to solve a problem, improve students' higher-order thinking in the Bloom Taxonomy (Lee & Lai, 2017). Stage of the flipped classroom, including pre-classroom, in the classroom, post-classroom (Kong, 2015). Flipped classroom facilitates student collaborative learning (Erbil, 2020). Flipped classroom enhance student-teacher interaction; student-student interaction, student content interaction (Špilka, 2015). Besides, implementing a flipped learning approach allows the teacher to use advanced technology to create the virtual classroom (Koohang et al., 2009). Students have more time to work in collaboration in class through flipped learning. To enhance proactive students, implementing flipped learning into an online learning environment facilitates students motivating, engaging, and persisting during the learning process. To promote the effectiveness of flipped classroom, learning resource materials as instructional video is designed, uploaded on learning management system (Kellam et al., 2012). Based on explored literature, the online learning model is elaborated in Figure 1.

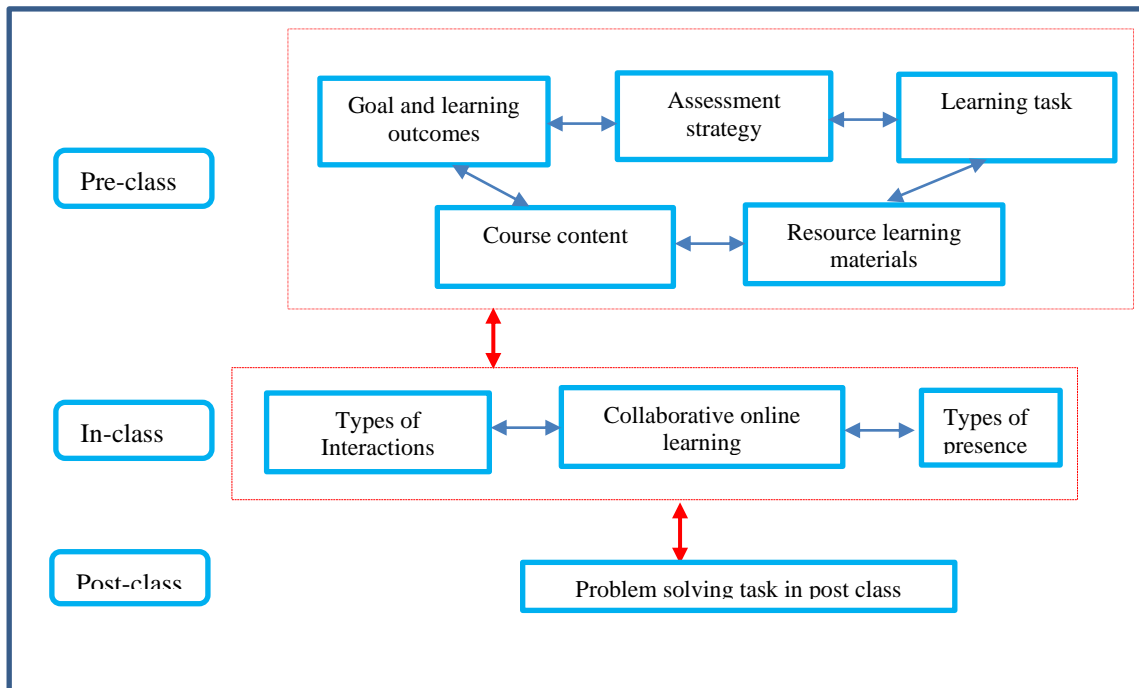


Figure 1: Courseware development for flipped learning

The literature review as described above is structured into a framework for an online learning model. This framework is used to construct questionnaire items, as shown in Table 1.

Table 1: Framework for effectiveness of online learning

Subscale	Description
Goal and learning outcomes	Goal and learning outcome are stated clearly for the course (Grubbs & Strimel, 2015)
Assessment strategy	Refers to developing an assessment plan corresponding to the learning outcome setting (Vonderwell & Boboc, 2013)
Learning task	A set of learning activities is served to build knowledge in relation to learning outcome statement. The learning task promotes students to involve in problem-solving by referring to resource materials (Richter, 2012)
Course content	Refers to organize content into groups, making relationships among the groups to effectuate task requirements.
Resource learning materials	Resource learning materials relate to instructional videos and quiz for the pre-class, and the post-class (Kellam et al., 2012)
Types of Interactions	A set of interactions in the virtual environment, such as student-content interaction, student-teacher interaction, and student-student interaction (O'dwyer et al., 2007; Aydin, 2013)

Collaborative online learning	Refers to collaborative learning techniques, such as determining the learning task, planning, executing, and validating the shared learning goal (Henri & Lundgren-Cayrol, 2001)
Types of presence	Refers to social presence, teaching presence, and cognitive presence (Anderson et al., 2001 ; Parrish et al., 2021)
Problem solving task in the post-class	Refers to mobilize the knowledge learned in the pre-class, the class time to solve problem task requirements.
Effective online learning	Refers to the students' feeling about the level of academic achievement compared to the learning outcome statement (Chang & Chang, 2012)

With regard to the effectiveness of online learning, Eom et al., (2006) mentioned that student satisfaction is significantly related to the learning outcome. Additionally, Graham & Scarborough (2001) stated that if learners feel satisfied with the online course during the learning process, then they become more motivated, engaged in the learning experience. Thus, it is necessary to explore what factors impact the level of student satisfaction. To enhance the effectiveness of online learning, Zhu, (2012) recommended that designing online courses and building an online environment must be emphasized to foster student interaction in online learning. Based on the literature mentioned above, as seen in Table 1, nine hypotheses are stated as follow:

- H1: The goal and learning outcome setting is effective for students,
- H2: The assessment strategy to students is effective for students,
- H3: The learning task is effective for students,
- H4: The course content is effective for students,
- H5: The collaborative online learning is effective for students,
- H6: The learning resource materials are effective for students,
- H7: The types of interactions are effective for students.
- H8: The types of presence are effective for students.
- H9: The problem-solving task in post-class is effective for students.

3. Research method

3.1. Empirical model and scale

Based on the theoretical framework for online learning this research proposed an online learning model when implementing collaborative online learning in the flipped classroom. The theory framework includes nine factors with 28 observed variables, as seen in Table 2.

Table 2: Measurement scales

Code	Measurement scales
GLO	I. GOAL AND LEARNING OUTCOME
GLO1	1 The goal is focused on students' learning needs
GLO2	2. The results based goal identify specific outcome which students know, and able do
GLO3	3. The attainable goal include an action that students can be accomplished
AS	II. ASSESSMENT STRATEGY
AS1	1. The teacher outlines the assessment plan clearly



AS2	2. The Teacher uses the assessment methods in accordance with the learning outcome setting
AS3	3. The teacher employed the formative assessment and feedback to students timely
AS4	4. The teacher evaluates and validate the level of competency the student has attained as compared to the learning outcomes setting
LT	III. LEARNING TASK
LT1	1. The learning task is concrete
LT2	2. The learning task relates to a real-world problem
LT3	3. The learning task facilitate collaborative learning
CC	IV. COURSE CONTENT
CC1	1. The prior knowledge and skills are considered to build a new one
CC2	2. The knowledge learned is applied to solve problems
CC3	3. The learning roadmap can help facilitate students learning
RLM	V. RESOURCE LEARNING MATERIAL
RLM1	1. The teacher provides perfectly appropriate learning support materials
RLM2	2. The assessment tool is effective
RLM3	3. The learning video is fully equipped
ToI	VI. TYPES OF INTERACTION
ToI1	1. The teacher communicates with students effectively
ToI2	2. Students use the learning resource materials effectively
ToI3	3 Student-student interaction and learning tasks are suits for learning
COL	VII. COLLABORATIVE ONLINE LEARNING
COL1	1. Collaborative learning motivate and engage students in the learning process
COL2	2. The learning task is appropriate for the collaborative online learning
COL3	3. The group size is appropriate for the collaborative online learning
COL4	4. The collaborative online learning tools are appropriate
ToP	VIII. TYPES of PRESENCE
ToP1	1. Social presence related to friendly communication
ToP2	2. Cognitive presence related to constructing new knowledge based on the prior one
ToP3	3. Teaching presence related to facilitation of discourse and direct instruction.
IX	XIX.PROBLEM-SOLVING TASK IN POST-CLASS
PST-PC1	1. The task assignments facilitate improving problem-solving skills
PST-PC2	2. Students mobilization knowledge to solve a given problem
PST-PC3	3. Problem-solving tasks help students to meet the desired learning.
EOL	EFFECTIVE ONLINE LEARNING
EOL1	1. Using collaborative online learning and flipped learning helps students meet learning outcomes
EOL2	2. Using collaborative online learning and flipped learning helps students develop problem-solving skills
EOL4	3. Using collaborative online learning and flipped learning to facilitate students engaging in the learning
EOL4	4. Students satisfy the online course using collaborative online learning and flipped learning

The study explores the relationship among the independent variables, including GLO, AS, LT, CC, COL, LRM, ToI, ToP, PST-PC, and the dependent variable EOL.

3.2. Research design

First, E-learning materials were designed and uploaded on Google classroom according to three the satge of the flipped classroom. Then, the online course was delivered via zoom cloud meeting. The online course took place for two months, from 10 February 2020 to 10 April 2020. After the online course finished, an online questionnaire was sent to students to survey students' perceived effective online learning.

3.3. Sample and sample size

In this research, the data were gathered from first-year students in the department of electronic and electrical engineering attending physics courses at Cao Thang Technical College, Ho Chi Minh-Vietnam. The survey was conducted with 300 students.

Based on the work of Hair et al. (2010), the sample size must be 5 times larger than the observed variables. In this study, the questionnaire includes 28 items, so the sample size is greater than 140. A total of 300 students took part in the survey, thus the sample size fits the research.

3.4. Research Instrument

The questionnaire items are designed for gathering data following the Likert scale, with the values (1) very dissatisfied, (2) dissatisfied, (3) neutral, (4) satisfied, and (5) very satisfied.

Instrument Validity

Content validation has been used in this study. Content validation is required to examine the structured questionnaire items. It is asked to check whether these items represent the entire framework theory of the designed model corresponding to the problem statement. The content validation is evaluated by experts who work in the field of educational measurement (Oluwatayo, 2012). A questionnaire can be considered as 'valid' if it measures what it aims to measure (A. Williams, 2003).

Instrument reliability

To check the instrument reliability, a preliminary study was conducted with 100 students who were not included in the study's sample. The data were processed, analyzed using Cronbach's alpha to test the reliability of questionnaire items (Cronk, 1999). In the pilot study, 28 items were used to calculate the reliability of the survey. Cronbach's alpha on all 28 items was 0.82, which indicates high reliability.

3.5. Data collection

The questionnaire includes goal and learning outcome (GLO), assessment strategy (AS), learning task (LT), course content (CC), collaborative online learning (COL), types of interactions (ToI), Types of presence (ToP); learning resource materials (LRM), problem-solving task in the post-class, and effective online learning (EOL). This questionnaire was sent to 400 students, received from 300, it is considered as a data collection.

3.6. Analyzing Data

The data were encoded, processed, and analyzed using SPSS 22.0.

3.6.1. Reliability Analysis by Cronbach's Alpha

The Cronbach's coefficient alpha was performed to evaluate the internal consistency coefficient of the 28 items, it is a way of measuring the strength of that consistency.

3.6.2. Exploratory factors Analysis

Exploratory factor analysis (EFA) is effectuated for a problem where the relationships between the observed and implicit variables are not certain (Yong & Pearce, 2013). EFA has been used in this study because that the structured questionnaire included the new items. Factors have been extracted from observed variables using the Varimax method. This method aims to reduce the items that have high loadings on each factor. Based on the work of Williams et al. (2010), EFA can be used based on some criteria. These criteria include factor loading > 0.5 , Kaiser-Meyer-Olkin (KMO) with a value between 0.5 and 1, Bartlett's test of sphericity ($\text{sig} < 0.05$), and the cumulative variance should be greater than 50%.

3.6.3. Regression analysis

We use the linear regression model to find the relationship between the dependent variable EOL and independent variables (GLO, AS, LT, CC, COL, ToI, ToP, LRM, PST-PC). Then, based on the regression function, we examine the impact of independent variables on the dependent variable. To run a regression analysis, the dependent and independent variables must have a linear relationship. Due to the research model with many independent variables, first, we have to check the correlation among independent variables (multi-collinearity) using a Variance inflation factor (VIF), the variables are accepted with $\text{VIF} < 10$. Second, we use Durbin Watson to test for autocorrelation. Finally, we have to examine the variance of the constant residuals based on the Spearman correlation.

4. Findings

4.1. Reliability test

Table 3 shows that the coefficients ranged from 0.781 to 0.951, indicating that all factors had a high rating for reliability. Thus, the online learning model includes nine measurement scales with 28 characteristic items.

Table 3: Cronbach Alpha Reliability test

Scale	Observed variable	Number of Items	Cronbach's Alpha
Goal and learning outcomes	GLO1, GLO2, GLO3	3	0.814
Assessment strategy	AS1, AS2, AS3, AS4	4	0.948
Learning task	LT1, LT2, LT3	3	0.870
Course contents	CC1, CC2, CC3	3	0.781
Learning resource Materials	AK1, AK2, AK3	3	0.805
Types of interactions	ToP1, ToP2, ToP3	3	0.840
Collaborative online learning	COL1, COL2, COL3	3	0.842
Types of presence	ToP1, ToP2, ToP3	3	0.980
Problem-solving task in post class	PST-PC1, PST-PC2, PST-PC3	3	0.831
Effective online learning	EOL1, EOL2, EOL3, EOL4	4	0.951

4.2. KMO and Bartlett test of sphericity

The KMO is used to verify the sampling adequacy for analysis. In this study, the KMO has a value of 0.805. Based on the work of Kaiser (1974), this KMO value is accepted. Bartlett's test of sphericity is smaller than 0.05, indicating that correlations between items were suitable for EFA, as shown in Table 4.

Table 4: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Adequacy.	Measure of Sampling	.805
Bartlett's Test of Sphericity	Approx. Chi-Square	10438.239
	df	406
	Sig.	.000

Table 5: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.035	31.155	31.155	9.035	31.155	31.155	3.664	12.634	12.634
2	2.518	8.684	39.839	2.518	8.684	39.839	3.046	10.505	23.139
3	2.247	7.747	47.586	2.247	7.747	47.586	2.938	10.130	33.269
4	1.994	6.876	54.462	1.994	6.876	54.462	2.496	8.608	41.876
5	1.900	6.551	61.013	1.900	6.551	61.013	2.403	8.288	50.164
6	1.771	6.106	67.119	1.771	6.106	67.119	2.329	8.032	58.196
7	1.492	5.144	72.264	1.492	5.144	72.264	2.309	7.962	66.159
8	1.440	4.966	77.230	1.440	4.966	77.230	2.234	7.703	73.862
9	1.221	4.211	81.441	1.221	4.211	81.441	2.198	7.579	81.441
.....									
29	.010	.034	100.000						

Extraction Method: Principal Component Analysis.

To extract factors from the observed variables, the principal component and varimax rotation have been used. Table 5 shows that the total percentage of variance explained is 81.4%, meaning that 81.4 % of the variance is accounted for by the first nine factors. In this study, the factor loadings get a value higher than 0.5 for all the factors. Based on the work of Williams et al. (2010), these factor loadings are accepted for EFA.

4.3. Regression analysis

Multiple Regression Analysis (MRA) is performed to test the theoretical framework. Nine variables are used to verify the research framework. The results show the R² value is 0.799 and adjusted R² is 0.793, as shown in Table 6. Table 7 indicates that the p-value for Anova analysis is smaller than 0.05 at 95% confidence level, therefore the theoretical framework fits with the actual data. There is no multi-collinearity because the VIF ranged from 1.152 to 1.670,

smaller than 10, as shown in Table 8. Additionally, the Durbin Watson, with a value of 2.053, revealed that there is no autocorrelation because the Durbin Watson has a value between 1 and 3, as seen in Table 6. Table 8 shows that the regression coefficients of all the independent variables are not equal to zero, due to all the sig <.05. These findings prove that the theoretical model is built in accordance with the reality.

Table 6: Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.894 ^a	.799	.793	.11248	2.053

a. Predictors: (Constant), PST-PC, CC, ToI, LT, GOL, ToP, LRM, COL, AS

b. Dependent Variable: EOL

Table 7: Anova^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	14.628	9	1.625	128.463	.000 ^b
	Residual	3.669	290	.013		
	Total	18.297	299			

a. Dependent Variable: EOL

b. Predictors: (Constant), GOL, AS, LT, CC, COL, LRM, ToI, ToP, PST-PC

Table 8: Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.465	.103		14.165	.000		
	GLO	.066	.018	.108	3.641	.000	.783	1.277
	AS	.113	.015	.257	7.641	.000	.614	1.630
	LT	.072	.017	.122	4.184	.000	.810	1.235
	CC	.098	.019	.146	5.186	.000	.868	1.152
	COL	.169	.025	.218	6.648	.000	.641	1.560
	ToP	.073	.017	.132	4.415	.000	.770	1.299
	ToI	.081	.017	.145	4.737	.000	.739	1.353
	LRM	.048	.019	.079	2.469	.014	.678	1.474
	PST-PC	.132	.020	.205	6.576	.000	.708	1.412

a. Dependent Variable: EOL

Testing the variance of the constant residuals, which is called homoscedasticity, has been effectuated using the Spearman correlation. Due to the p-value of nine variables are greater than 0.05, therefore there are no variables eliminated from the theoretical framework. As a result, the model of effective online learning consists of GLO, AS, LS, CC, COL, ToI, ToP, LRM, and PST-PC.

5. Discussion

After testing the variance of the constant residuals, the variables in the model include GLO, AS, LS, CC, COL, ToI, ToP, LRM, and PST-PC. The correlation between the nine independent and the dependent variable are described by the following equation:

$EOL = 1.465 + 0.066 GOL + 0.113AS + 0.072LT + 0.098CC + 0.169COL + 0.073ToP + 0.081ToI + 0.048LRM + 0.132 PST-PC$. The equation shows that there is a positive relationship between the independent and dependent variable:

- From the regression equation, we find that the variable COL has the most significance on the EOL with the coefficient of 0.169, this is explained that if students evaluate this factor increasing by 1 point, then EOL will increase by 0.169. The finding from the research was consistent with the work of Dillenbourg (1999) and Henri & Lundgren-Cayrol (2001), these authors stated that collaborative online learning should be clarified so that students can be able to learn and share their common goal learning. The results of this research showed that FC promotes collaborative online learning to motivate and engage students in working together to construct and apply acquired knowledge to solve a problem. This finding was consistent with the work of Jdaitawi (2019), who stated that FC also promotes students to work in collaboration to build new knowledge concerning the learning task through online collaborative tools. The results of the study showed that implementing COL in FC has helped to foster increased cognitive presence, social presence and create a meaningful learning experience.

- With regard to the variable AS, we find that there is a positive relationship with EOL dependent variable. The result is consistent with the work of Andrade (2015), who stated that effective instruction requires feedback and assessment effectiveness. The assessment strategy promotes student motivation in learning. The role of feedback and formative assessment have improved the virtual learning course. The assessment strategy in this study consist of three stages, including pre-class, in the class, and post-class. The purpose of the Pre-class assessment is to check for students understanding the concepts after watching the instructional video related to the objective and learning outcome statement. In-class time, the assessment is established to check for students mastering knowledge learned. Post-class assessment is effectuated through a given problem-solving task to check for students meeting the desired learning outcome.

- With respect to the variable GLO, we detect that this variable positively impacts the EOL dependent variable. Indeed, setting a goal, objective, and learning outcome have encouraged students understanding the importance of learning strategy, helped them determine assessment strategy, providing them with the content roadmap, the plans of learning tasks to complete desired learning goals successfully. This result aligned with the work of Andrade (2015) and Djudin (2018), who mentioned that effective learning goal setting enhanced effective online learning for students. Concerning flipped classroom, students get started with the course content through an instructional video in the pre-class. In class time, they synthesize knowledge explored, complete a learning activity aligned with class objectives, and learning outcome.

- In terms of the variable LT, we find that there is a positive correlation between the LT and the EOL variable. Indeed, in this study, the learning task is designed to facilitate students constructing new knowledge based on the prior one. Richter, (2012) mentioned that the learning task is used to help students interact with learning materials, their teacher, and their peers to promote a meaningful learning experience.

- Concerning the variable CC, we discover that the dependent and independent variables have a positive correlation. Indeed, in this research, the teacher provides students with a content roadmap by which students connect new knowledge with previous one. The roadmap encourages students' motivation, performance. Indeed, Roksa et al. (2017) found that clear

course structure and teaching clarity motivate students, improve their persistence, and raise their performance.

- As regards to the variable ToI, we find that this variable and dependent variable (EOL) are positively correlated. The results were consistent with those from the previous finding by Martínez-Caro (2011) and Baleni (2015) who indicated that interaction between students and teacher play an important role in online learning (Madland & Richards, 2016). The finding of research showed that FC enhances increased interaction between students and content. Indeed, in this study, the pre-class teacher requires students to watch instructional, and complete quizzes before going to synchronous learning sessions. In-class time, students apply knowledge learned to solve a given problem. In the post-class, the student is required to solve another problem to consolidate knowledge.

- With respect to the variable ToP, we find that this variable affects the effectiveness of online learning. Indeed, to motivate students in the learning process, promote their persistence, the cognitive presence is effectuated during the learning experience, in which students begin learning with a problem, they construct new knowledge based on the prior one. During the learning process, teaching presence is established to clarify the goal and learning outcome, refer students to learning resource material, diagnose misconceptions, provide instructive feedback, and encourage student-student discussion. Social cognitive relate to building a positive rapport by open, friendly communication. Types of presence play an important role in an online learning environment. The result aligned with the work of Garrison et al. (1999), who mentioned that types of presence represent a process of creating a deep and meaningful learning experience.

- Concerning the variable LRM, the finding revealed that the effect of the use of the resource materials contributes to enhancing the effectiveness of online learning positively. Indeed, LRM support student learning, motivate them to engage, explore, elaborate pre-knowledge course through watch instructional videos, quiz, problem-solving tools. As a result, LRM plays a vital role in virtual learning, it is the key part of flipped learning, and it is also a factor affecting students' academic achievement.

- With regard to the variable PST-PC, we find that there is a positive correlation between the independent and dependent variables. Indeed, PST-PC variable relates to post-class assessment activities that are clearly connected to pre-class and the in-class with synchronous learning. At this stage, both formative and summative assessments are established: The assessment formative consists of multiple-choice questions with answers. The summative assessment relates to the problem-solving task. Basing on the problem-solving process, the teacher evaluates students' problem-solving skills as compared to the learning outcome setting. It is a crucial factor to promote the student's learning to meet the desired learning.

The results show that nine independent variables viz. GOL, AS, LT, LRM, COL, ToI, ToP, and PST-PC positively impact students' satisfaction and further students' satisfaction positively impact the effectiveness of online learning (EOL). In this study, we have proposed, evaluated a theoretical framework for online learning to enhance effectiveness in virtual learning when implementing collaborative online learning into flipped learning. These above-mentioned factors involved students engaging and persisting during the learning process, including the pre-class, the in-class, and the post-class. Pre-class activities must be designed carefully to assist students to learn key concepts, improving their confidence and motivation to engage in working in collaboration in-class time that lead to validating and applying the learned knowledge. Post-class assessment activities are linked to pre-class and in-class time through a problem-solving task. The online course designed with the flipped classroom helps students work in collaborative group, build knowledge, develop self-learning, self-regulation compared to the learning outcome statement.

6. Conclusion

In this study, we have implemented an online course when implementing a flipped classroom with collaborative online learning through a physics course. Nine variables that were identified during the learning process include GLO, AS, LT, CC, COL, ToI, ToP, LRM, and PST-CT. The results of the study show these independent variables positively impact students' satisfaction and further students' satisfaction positively impact the effectiveness of online learning (EOL). These results lead us to validating, generalizing the online learning model when implementing collaborative online learning in flipped classroom in the future to enhance effective online learning, both asynchronous and synchronous types.

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