The Role of the Flipped Classroom Pedagogy on the Engagement of Architectural Engineering Students: An Action Research

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Abstract

This action research study aims to explore the effectiveness of the Flipped Classroom (FC) teaching strategy in the engagement of architectural engineering students in a construction technology course. The FC method is a form of blended learning that significantly improves student learning over face-to-face or online courses. The research objectives are as follows: to design an evidence-based FC; to test how the use of technology in the FC method will affect students' engagement; to verify the extent to which class activities affect the students' ability to apply their acquired knowledge about the topic; to evaluate the FC experience versus the traditional lecture method. Research The Class was structured in four parts: purpose, prior-to-class activity, in-class activity, and closing. Data is collected using observation and survey.   The researcher concluded that: the FC method was effective in engaging students; the engagement with technology is dependent on the level of achievement using that technology; the researcher should perform summative assessments before the FC to ensure students' preparation; the quiz, competition, and exhibition were suitable activities to the topic selected.

Keywords
Flipped classroom pedagogy, Students' engagement, Action Research, and Flipped classroom activities.

1. Introduction

Using the proper instructional method is crucial in enhancing the students' engagement. Student engagement is a process and product of keeping students involved, motivated, and actively learning. The FC method is a form of blended learning that significantly improves student learning over face-to-face or online courses. The merit of the Flipped Classroom (FC) pedagogy is a form of blended learning which, when done well, significantly improves student learning over that in face-to-face or online courses (Mertler, 2017).

1.1 Objectives

The research objectives are as follows: to design an evidence-based FC; to test how the use of technology in the FC method will affect students' engagement; to verify the extent to which class activities affect the students' ability to apply their acquired knowledge about the topic; to evaluate the FC experience versus the traditional lecture method.

2. Literature Review

The FC is defined by many authors as an instructional method in which the delivery of the class content is done out of the Class, and the class time is freed up for more meaningful learning activities and engagement with the application of knowledge acquired in the preparatory work. While prior-to-class activities include watching recorded lectures (webcast); listening to a podcast; reading a set text prior to the scheduled class time; watching video demonstrations, in-class activities include: discussions; exercises; projects; games; competitions; graphic organizing; problem-solving; reciprocal teaching; and writing. FCs have three versions; the purest is the one where the instructor records his lecture on videos or in podcasts, less pure version where the instructor assigns videos or podcasts made by someone else; loosest use of FC instructor ensure that students get their first exposure to new material outside Class. A major problem with the flipping method is that some students object to the lack of lectures and the shift to teaching themselves. The merit of FC is that it's a form of blended learning which, when done well, significantly improves student learning over that in face-to-face or online courses.

Barkley and Major (2016) shortlisted 10 top Learning Assessment Techniques mapped to the six learning domains of the Significant Learning Taxonomy (Table 1). For the FC case study, the learning domain is the foundational knowledge using the technique of guided reading notes, which was the lecture notes, and team-tests which was the quiz and window design competition. The learning domains and Learning Assessment Techniques are as follows:

Table 1: The learning domains and Learning Assessment Techniques. (source: Barkley and Major, 2016)

Domain	Learning Assessment Technique
Foundational Knowledge	Guided Reading Notes; Team-Tests
Application	Fact or opinion; What's the Problem
Integration	Sequence Chains
Human Dimension	Ethical Dilemma
Caring	Proclamations
Learning How to Learn	Student-Generated Rubric; Invent the Quiz; Multiple Task Mastery Checklist

3. Methods

According to Honeycutt (2016), a FC is planned in four parts: purpose, prior-to-class activities, in-class activities, closing. The instructor targeted the sophomore students section having a Construction Technology II Course which is about building materials, products, components, and assemblies and their application on buildings. The specific topic selected for the FC is "Windows," which is one of the important components of buildings. Students were informed about the FC and the expected in-class activities two weeks prior to the day of the activity.

The purpose of the Class was to introduce windows as a basic wood material component in the Construction Technology II Course to achieve the following objectives: to understand different window types, louvers, and

skylights; to estimate the sizes of the different elements of a window; to design a window of your choice; to understand technical terms related to windows. This was followed by mapping class objectives to the course learning outcomes. As a prior-to-class activity, students were assigned a lecture about windows prepared by another instructor teaching another section of the same course, and this is considered as a less pure version of FC. In-class activities included a quiz using an online digital tool known as Kahoot! which is "…. a game-based learning platform that makes it easy to create, share and play learning games …." (www.kahout.com). This quiz is intended to be a formative assessment of the understanding of the lecture material. Table 2 demonstrates the quiz questions with answer keys highlighted in grey color.

Table 2: Quiz Questions

1	The Image is an example of the classic windows of the British Style			
	True		False	
2	Which of the following is not a function of windows?			
	Lighting	Ventilation	Accessibility	View
3	Pop-out windows are an example of projecting windows			
	True		False	
4	All windows are glazing windows			
	True		False	
5	The Image is what type of windows?			
	Sliding	Double hang	Hopper	Awing
6	The location of a window sill is to the top of the window, and the lintel is at the bottom.			
	True		False	
7	The window's rough opening is larger than the sash opening			
	True		False	
8	The image is an example of what kind of louvers:			
	Vertical	Horizontal	Egg crate	Vertical & Horizontal
9	The operating systems of louvers are: 1. Manual 2. Motorized 3. Roller type			
	True		False	
10	The functions of skylights are the same as windows except in			
	Heat control	Privacy	Ventilation	Light

Another main in-class activity included a competition for students to design the dream window of their rooms. The main objective of the competition is that they use all the knowledge they gained about windows in designing their windows. Then a Fantasy Exhibition was made where students were asked to post their work and vote for the winning design. A winner was chosen. The closing activity was a highlight of the class objectives achieved and a feedback survey using the "www.kahoot.com" activity. The feedback survey questions were as follows:

Q1. How do you rate your experience with the Flipped Class versus the traditional?
Q2. How do you rate the clarity of the purpose of the Class was?
Q3. Rate your satisfaction with the level of difficulty of the pre-class activity
Q4. The class "kahoot" activity was?
Q5. Your experience with the Fantasy Exhibition is?
Q6. Are you satisfied with your understanding of different windows: types, louvers & skylights?
Q7 Are you satisfied with your ability to apply your understanding to your window design?
Q8. Are you satisfied with your ability to estimate the design of the main elements of windows?
Q9. Are you satisfied with your understanding of technical vocabulary about windows?
Q10. Would you be interested in having more flipping of your classes?
Q11. Did you do the class reading at home?

4. Data Collection

The researcher adopted two methods of data collection. Primary data was collected using quantitative and qualitative methods. The quantitative method included using online digital tools for quiz and feedback surveys performed during and at the end of the Class. The qualitative which is the researcher observation method and design competition voting. Secondary data was collected from relevant books and journals. Data is analyzed automatically by the online digital tool (Kahoot), giving the mean values used by the researcher to test students' knowledge.

5. Results and Discussion

The number of students who attended the Class was 11 out of 15. The low attendance was because students had multiple submissions for other courses on the same day of the FC activity. There is an obvious correlation between the overall performance in the online quiz (Kahoot activity) regarding the percentage of correct to incorrect answers (58%-42%), [Fig. 1] and the percentage of students who did the class reading and those who didn't (55%-45%) [Fig. 2]. Thus, the quiz given at the beginning of the Class must be part of the summative assessment of the course so that students will take their readings seriously.
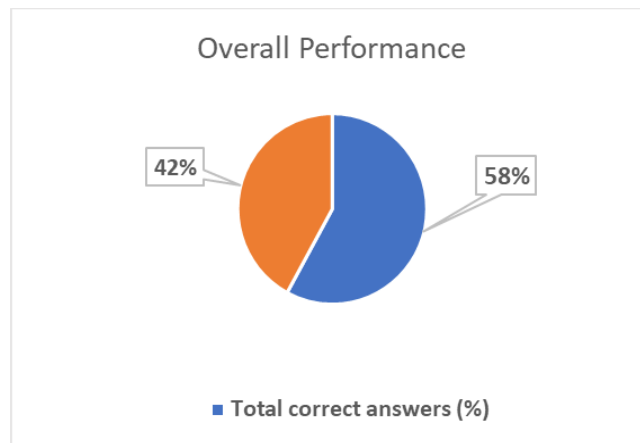

Fig. 1: Results of the in-class formative assessment quiz
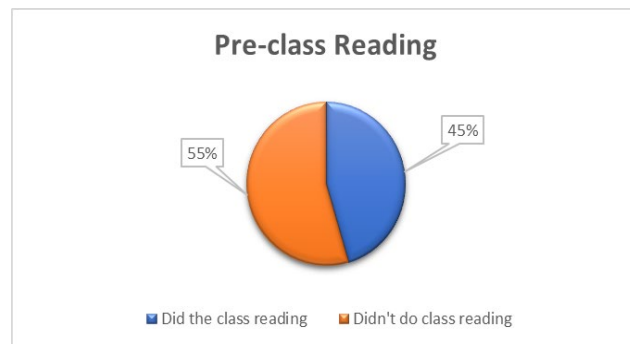

Fig. 2: Percentage of Students who did the Pre-class Reading

According to the observation of the researcher, the students were very enthusiastic with the "kahoot" activity, but as shown in Fig. 3, students were more interested in the Fantasy Exhibition (mean score 3.3/4) than the "kahoot" activity (mean score 2.9/4). This unexpected result is not because students were not interested in the use of technology, but the "kahoot" activity required they are well prepared for the Class. This emphasizes the fact that the use of technology for student engagement is dependent also on their level of achievement using that technology.
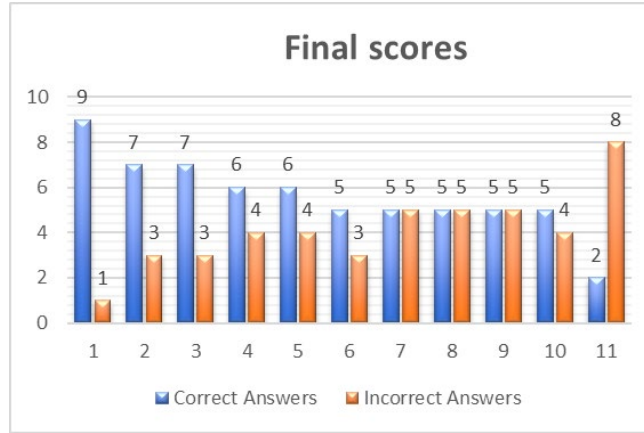
Fig. 3: The Breakdown of Grades for the Formative Quiz.

Fig. 4 shows the results of the feedback survey result on the FC pedagogy. The highest mean score was given to the preference of the students to have more FC, which reflected that students felt more engaged in this mode of instruction. The least mean score was given to given to question about understanding basic principles. This could be interpreted in two ways. First is that students were not used to this mode of instruction where they had to read a lecture on their own. The second reason because some of them didn't do the pre-class reading, which affected their evaluation of understanding of the basic concepts.
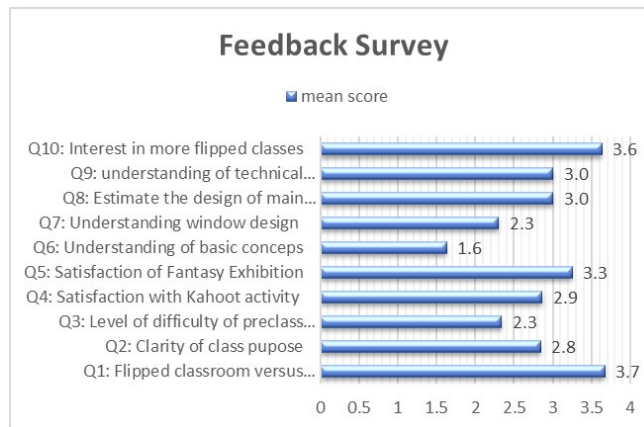

Fig. 4: The Feedback Survey Rating out of 4

Considering the satisfaction of students with the Fantasy Exhibition 3.3/4 and the low percentage of 55% of participation which is almost half of the Class didn't participate in the activity, again reflects that the students' participation would be more if they were prepared more for the Class.
Students evaluated their preference to have FC with a mean score of 3.7/4 and showed their interest in having more FCs with a mean of 3.6/4, which emphasizes student engagement with the FC experience.

6. Conclusion

FCs have three versions; the purest is the one where the instructor records his lecture on or in podcasts, less pure version where the instructor assigns videos or podcasts made by someone else; loosest use of FC instructor to ensure that students get their first exposure to new material outside Class. The researcher adopted the less pure version of FC by using a lecture about windows prepared by another instructor teaching another section in the same course.
FC is structured into four-stage: purpose, pre-class activities; in-class activities; and closing. The purpose of the Class was to introduce windows as a basic wood material component in the Construction Technology II Course to achieve the following objectives: to understand different window types, louvers, and skylights; to estimate the sizes of the

different elements of a window; to design a window of your choice; to understand technical terms related to windows. As a prior-to-class activity, students were assigned a lecture about windows prepared by another instructor teaching another section of the same course, and this is considered as a less pure version of FC. Only 55% of the students did the pre-class reading. In-class activities included a quiz using an online digital tool known as Kahoot. This quiz is intended to be a formative assessment of the understanding of the lecture material. The percentage of correct to incorrect answers was 58-42% which is consistent with the percentage of those who didn't do the pe-reading. Thus, the quiz given at the beginning of the Class must be part of the summative assessment of the course so that students will take their readings seriously. Another main in-class activity included a Fantasy Competition for students to design the dream window of their rooms. The main objective of the competition was that they use the knowledge they gained from the lecture in designing their windows. Then students were asked to post their work and vote for the winning design. A winner was chosen. On comparing the mean value of rating the online quiz and the fantasy competition, students rated both activities as 2.9/4 and 3.3/4, respectively, which proves that students were more engaged with the fantasy exhibition than the online digital tool. This emphasizes the fact that the use of technology for student engagement is dependent also on their level of achievement using that technology. The closing activity was a highlight of the class objectives achieved and an online feedback survey using an online digital tool.

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Biography

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