Research Paper

Enhancing transfer of learning through flipped classroom using an instructional design model: A case study in college physic course in Vietnam

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ABSTRACT

Transfer of learning is one of the vital elements in the teaching and learning process. The purpose of the work is to know the influence of flipped classrooms on the transfer of learning about "force and motion" topic. We use a quasi-experimental research design with a non-equivalent control group pre and post-test design. The population of this study was all students of the department of mechanical engineering at Cao Thang Technical College in Vietnam in the 2021-2022 school year. The sample consisted of 80 control class students and 82 experimental class students. The experimental class uses the flipped classroom while the control class uses the conventional model. The pre-test and post-test are used as data collection instruments. Finding from this study showed that there were differences in academic achievement between flipped learning and conventional learning. Using instructional design for flipped learning enhanced the transfer of learning.

Key words: Instructional design, flipped classroom, transfer of learning.

INTRODUCTION

The primary goal of education is to facilitate students to apply their acquired knowledge in different contexts. Thus, promoting students to identify, combine, and integrate knowledge learned to solve problems related to the real world is important in the field of education. There is a lot of research on the way of applying knowledge learned to solve problems in order to develop students' competencies, but there has been little research on the transfer of learning at the college level, especially in the online learning environment. Hence, finding a model of transferring knowledge is necessary for students to develop competencies in problem-solving. Transfer of learning requires students to be proactive during the learning process. Moreover, this learning approach compels students to take responsibility for their own learning. By exploring the literature review on science education, we found that flipped classroom (FC) focuses on students centered learning activities (Prevala and Uzunboylu, 2019). In addition, FC also improves students' higher-order thinking skills (Lee and Lai, 2017). With regard to designing for FC, an instructional design model for flipped learning in higher education has been developed by Lee et al. (2017). We assume that using the instructional design model for FC facilitates student transfer of learning.

LITERATURE REVIEW

Transfer of learning is defined as an application of acquired knowledge and skills in different contexts (Roediger and Butler, 2011). The teaching and learning process is considered to be effective when students are able to mobilize, combine, and integrate knowledge learned into a new situation. The learning can be transferred from one situation to another when two situations are likely similar. Thus, the level of transfer is determined by the level of similarity between the learning context and the context of mobilizing knowledge learned to solve problems (Hajian, 2019). In other to facilitate students transferring acquired knowledge to new situations, the learning task should be
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Figure 1: Instructional design model for flipped learning

taken in the real world situation. According to Sadler (2009), learning tasks must be situated through meaningful authentic activities. Merrill (2002) also stated that the transfer of learning is promoted when students are involved in real-world problems. We assume that the degree of transfer of learning depends on the instructional design model. Thus, in this study, we used the backward design model to design a course. This model is composed of three stages, including identifying the intended learning, the assessment strategy, and learning activities (McTighe and Thomas, 2003). The goal and learning outcome setting is based on Bloom’s taxonomy of learning (Bloom, 1956). We plan and develop the assessment strategy and learning activities based on the learning outcomes. The learning activities are designed according to the three stages during the learning process, namely, contextualization, de-contextualization, and re-contextualization.

Contextualization is the process of putting information into context, making sense of information from the situation in which information was found. De-contextualization is defined as a way of building a regular, a concept, a law, and a model. Re-contextualization is the process of mobilizing the knowledge learned into a new situation (Tardif, 1999). Thus, the transfer of learning occurs in the stage of the re-contextualization. During the learning process, acquisition of knowledge is extremely important, but more importantly students also need to be taught how to transfer knowledge to different situations. Hence, students need to learn how to identify, select, combine, and integrate knowledge learned into new situations. The transfer knowledge is not limited to apply knowledge to do a simple exercise, but requires students to apply knowledge learned to solve a complex problem. In order to practice the problem-solving process, students need more time to work in collaboration with their teacher and their peer in class time. Concerning this aspect, flipped classroom (FC) approach can be used. The FC positively impact on self-regulated learning (Jdaitawi, 2019). FC also facilitates student problem solving (Park and Han, 2018). FC composed of three stages (Kong, 2015): Pre-class activities, students are asked to study the goal learning, and the scenario learning. Students are required to watch the instructional video, by which student complete quizzes before going class. In class time, teacher check for students understanding the concepts, validating the core knowledge, and teacher reserve more time for students to identify and mobilize knowledge learned to solve problem related to real situation. Moreover, through in-class activities, teachers can check students' misunderstandings about the course content (Davies et al., 2013).

Post-class activities, students are asked to review the learning activities in class time, students are also given a complex problem, they are required to solve independently. The pre-class learning plays an important role for in class time. If students don’t spend time on studying, watching, exploring the core knowledge, and completing the quizzes in the learning platform prior to class, they might not catch up with their peer during the problem-solving in class time. With regard to this aspect, Blau and Shamir-Inbal (2017) stated that students are unprepared for the course they might not take part in learning activities. In this study, the FC has been designed by combining the backward design and the model of ADDIE (analysis, design, development, implementation, and evaluation) (Ghirardini, 2011). The relation between ADDIE model and backward design are presented according to the stages of FC as shown in Figure 1. In Figure 1, at the stage of analysis, we analyze students’ learning needs in order to determine the desired learning
outcomes, the assessment plan, and learning activities. Related to the stage of design, the assessment strategy and learning activities are planned to help support a flipped classroom model. The learning material is designed for students to learn outside of class and in class. Concerning the stage of development, the learning material and assessment plan are fitted together into a module of learning. Besides, learning activities are elaborated to promote the flipped format. With regard to the stage of implementation, teacher-student interaction, student content interaction, and interaction among students have been effectuated in the learning process. The evaluation takes place during the class, including pre-class, in-class, and post-class.

RESEARCH METHOD

Research context

This study was carried out to first-year mechanical engineering students at Cao Thang Technical College in Ho Chi Minh, Vietnam. Owing to the COVID-19 pandemic, the online course was designed, developed, implemented through google classroom and google meet. The learning resource materials were uploaded on Google classroom such as power-points presentations, e-books, quizzes, and instructional videos. Students watch these videos and complete these quizzes at home before participating in the synchronous learning. The online course took place from 26 October 2021 to 26 November 2021.

Research design

The quasi experimental design was chosen in this study because students are not randomly assigned to conditions, classes had been administered by an institutional school. The study was designed as a pretest-posttest control group. The independent variables were two different types of instructional approaches: one is conducted with flipped classroom and the other was effectuated with the conventional method. The dependent variable was students’ academic achievement. Each class was given both a pre-test and a post-test, measuring the test result before and after intervention study.

Sample

The population of this study were all first year students in the faculty of mechanical engineering at Cao Thang Technical college, Ho Chi Minh, Vietnam. All first-year students of mechanical engineering faculty consist of five classes. Two classes were chosen from five and they were randomly assigned as experimental and control group (experimental group, N = 82; control group, N = 80). This study was carried out in the first semester, 2021-2022 academic year.

Instrument and data collection

Instrument

A multiple choice question (MCQ) is used as an instrument to gather the data. It was built based Bloom’s taxonomy. In this study, the MCQ is built based on the physics learning outcome at Cao Thang Technical College related to the “Force and motion” topic. MCQ items formats consist of four response options (e.g., one correct answer and three distractors). The MCQ test consists of 20 items designing on Bloom’s taxonomy including the first four-level that is, remembering, understanding, applying and analyzing, as seen in Table 1. Table 1 shows that items of “remembering” and “understanding” account for 20% of the total score (4 of 20 items), and 80% of the total score on the items of “applying” and “analyzing” (16 of 20 items). As the study aims to estimate the transfer of learning to a situation; thus, the number of items of “applying” and “analyzing” are higher than the “remembering” and “understanding”.

Validity and reliability of instrument

Instrument Validity

Content validation has been used to examine the items of
MCQ for the pre-test and post-test. It means that checking whether these items meet the physics learning outcomes. These items are examined by two physics teachers on one hand and on the other hand these items are validated by experts in the field of educational assessment and measurement. With regard to the instrument validity, Williams (2003) also stated that the assessment test can be validated when it measures what it aims to measure. Expert opinion from physics educators and science education lecture helps the researcher in completing the content validity. The required modifications were made in accordance with experts’ recommendations.

**Reliability of instrument**

The reliability of instrument was effectuated using the Kuder-Richardson 21 formula. This instrument was tested with a pilot study for 45 first year students, who were not included in the sample. After computing the data, we found that the reliability coefficient is 0.6. Thus, we concluded that the instrument was suitable for the study.

**Teaching organization**

**Designing and developing, and implementing online course**

Based on goal and learning outcome statements, teachers identify the core knowledge related to the topic of “Force and motion”. Teachers also plan the assessment strategy, and provide learning activities for students. Moreover, teachers provide the scenario of learning with FC for students. The experimental class was delivered with FC while the control group was taught using the conventional method. Both EC and CC are taught in the online learning environment, as see in Table 2. The flipped classroom treatment consisted of instructional video, quizzes, and interactive problem-solving. Students in the control group received a lecture in class with identical content to the instructional video lecture. They were also given the same problems to work on as the treatment group, but to solve outside of class.

**Data collection**

Before the intervention study, both experimental and control group took part in the pre-test. After the pre-test was over, the experimental group was taught using FC on the “force and motion” topic. For the control group, the same content knowledge was delivered using the conventional method. Both the experimental and control group were taught in parallel for ten teaching hour. The post-test was applied to both groups. The tool for collecting data comprised of 20 items, as seen in Table 1. The items in the pre-test and post-test were identical, but in the post-test, these items were reshuffled. Due to the COVID 19 pandemic, schools were forced to close, the online course was implemented. Thus, both groups took the pre-test and post-test through google form during 45 min.

**Tool for data analysis**

The software SPSS 22 was used in this study as a tool for analysis. The data were collected before and after applying of FC. Kolmogorov-Smirnov test was used to check the normal distribution of the data. When running Kolmogorov-Smirnov test, we found that the p-value was over 0.05, thus the data are considered a normal distribution.

### RESULTS

To verify whether there were differences in the academic...
Table 3: Pre-test mean score of the control group and experimental group

<table>
<thead>
<tr>
<th>Test group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>82</td>
<td>4.94</td>
<td>1.37</td>
<td>1.12</td>
<td>0.26</td>
</tr>
<tr>
<td>Control</td>
<td>80</td>
<td>4.70</td>
<td>1.32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Post-test mean score of the control group and experimental group

<table>
<thead>
<tr>
<th>Test group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>82</td>
<td>7.00</td>
<td>1.34</td>
<td>4.69</td>
<td>0.000</td>
</tr>
<tr>
<td>Control</td>
<td>80</td>
<td>5.90</td>
<td>1.67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

achievement between the experimental and the control group, the independent samples t-tests in pre-test and post-test were effectuated. Data collected from the pre-test and post-test were run statistically. The results of the statistical computing are presented in Table 3. As seen in Table 3, there is no statistically significant difference in mean score of experimental group (M = 4.94; SD = 1.37) and control group (M = 4.70; SD = 1.32, t(160) = 1.12, p = 0.26), at 95% confidence intervals level. The calculated p-value was greater than 0.05, t distribution for the degrees of freedom (df = 160) is 1.96, the calculated t-value is 1.12. As the calculated t-value is smaller than the distribution t-value, the p-value is greater than the alpha level: p >.05. We can accept the null hypothesis that there is no difference between means. Hence, it was concluded that both classes were homogeneous in learning ability based on the “force and motion” topic prior to the intervention. As seen in Table 4, there is statistically significant difference in mean score of experimental group (M = 7.00; SD = 1.34) and control group (M = 5.90; SD = 1.67, t(160) = 4.69, p = 0.000), at 95% confidence intervals level. The calculated p-value was smaller than 0.05, t distribution for the degrees of freedom (df = 160) is 1.96, the calculated t-value is 4.69. As the calculated t-value is greater than the distribution t-value, the p-value is smaller than the alpha level: p <.05. We can reject the null hypothesis that there is no difference between means. We concluded that implementing FC enhanced the students' ability to transfer of learning for the experimental group.

**DISCUSSION**

The finding results showed that there is a statistically significant difference in the academic achievement between the experimental and control group, it means that FC positively affects the transfer of learning as shown in Table 4. Thus, using the FC was likely to enhance student learning outcomes. This is explained that the 25% of the class time is reserved for summing the core knowledge that students had explored at home, and the 75% of the class time is reserved for working on problem-solving skills. Thus, with FC students have more time in class to practice problem-solving skill such as situation analysis. During the problem-solving practice, students have compared between the learning situation and problem-solving situation, identified the acquired knowledge, and applied them to solve problem. This learning style facilitates students’ transfer of learning. The result of this research showed that in the class time, FC involved students in a complex problem in which students identify the appropriate knowledge learned to find out a solution by working in collaboration with supporting from their teacher and their peer. As students have more time in class, they get real-time feedback from teachers. The teacher’s feedback helped students to overcome difficulties when they are faced with the problem-solving situation. In order to optimize the effectiveness of learning activities in class time, teacher strictly require student to watch video lecture, complete quizzes, and complete tasks requirements. Indeed Davies et al. (2013) recommend that students were asked to take notes while watching the lecture videos prior to class. As pre-study play an important role for learning activities in class time, the teacher should analyze the learning program and consider what contents students are likely to learn at home. Thus, elaborating the scenario learning is important for students to clearly understand what they study during the stages of FC. In this study, basically, the topic of “force and motion”, as seen in Table 1, had been studied by students in 10th grade. As a result, the FC for this topic is appropriate for first students in the department of mechanical engineering. Moreover, to improve the transfer of learning, we also recommend that the teacher should spend 25% of class time to validate core knowledge learned at home, the rest time, teacher helps students to practice the problem-solving skills to develop applying and analyzing skills for them.

**CONCLUSIONS**

In this study, the FC has been implemented in the physics course for first year student in the department of mechanical engineering. The study finding revealed that
there is difference in the academic achievement between the experimental and control group. The experimental group, in which FC was applied, got better results than the control group using the conventional method. The results demonstrated that the FC improved students’ effective learning outcome, helped student to identify, combine and integrate knowledge learned into new situations. Using instructional design for FC enhanced the transfer of learning in the online learning. This research also opens a new perspective for designing for deep learning with flipped classroom.

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REFERENCE


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