The Effects of the Flipping Classroom and Peer Instructional Models on Learning Mathematics

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Abstract
This study examines the impact of the flipped classroom and peer instruction teaching models on students' mathematics performance. More than one hundred students participate in a four-month study, and they are divided into three groups. A control group is being taught according to the traditional model. The first experimental group is being taught according to the flipped classroom model. A second experimental group is being taught using both a flipped classroom and a peer-instructional model. A quasi-experimental design is implemented, and three research tools are designed and used. These tools are YouTube channel, tests, and survey. We expect the results of this study to show that the performance of students in flipped classroom and a peer-instructional model class outperformed those in other two sections. This approach hopes to provide students with long-term learning as they are at the center of the learning process. In addition, this approach gives us the opportunity to know the math skills that each student needs. We hope to generalize this teaching model to other science majors. This educational model effectively contributes to quality education.

Keywords: Flipped Classroom, Peer-Instructional Model, Quasi-experimental Design, YouTube Channel

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Introduction

A flipped classroom is an instructional approach where students watch pre-recorded video lectures or complete readings before class, and then use class time to engage in hands-on activities, discussions, and problem-solving exercises. The goal is to shift the traditional lecture-based learning to a more interactive and engaging learning experience.

On the other hand, peer-instruction is a teaching method where students work in small groups to solve problems, answer questions, or discuss ideas. The instructor acts as a facilitator, providing guidance and feedback to the students as needed. Peer-instruction is designed to promote active learning, increase student engagement, and improve knowledge retention.

The flipped classroom and peer-instructional model can be used together to create a more effective learning experience. In a flipped classroom, students can watch the pre-recorded lectures or complete readings before class, and then use class time for peer-instructional activities. The instructor can assign small groups to work on a particular problem or topic, and then rotate among the groups to provide feedback and guidance. This approach encourages students to take responsibility for their own learning, promotes collaboration and teamwork, and creates a more engaging and interactive learning environment.

A number of studies have investigated the effectiveness of the flipped classroom and peer-instructional model in mathematics education. Several studies have found that the flipped classroom and peer-instructional model can lead to improved student achievement in mathematics. For example, a study by Lage et al. (2000) found that students in a flipped classroom model outperformed students in a traditional lecture-based model. Similarly, a study by Brame et al. (2013) found that students in a peer-instructional model had higher exam scores compared to students in a traditional lecture-based model. Also, the flipped classroom and peer-instructional model have been shown to increase student engagement in mathematics. For example, a study by Gannod et al. (2008) found that students in a flipped classroom model were more engaged and active during class. Similarly, a study by Lasry et al. (2014) found that students in a peer-instructional model reported higher levels of engagement and motivation. These models have been found to promote self-regulated learning in mathematics. For example, a study by Smith et al. (2016) found that students in a flipped classroom model were more likely to take responsibility for their own learning and engage in self-regulated learning strategies. On another side, the role of the teacher in the flipped classroom and peer-instructional model is important. Studies have found that effective implementation of these models requires a shift in the teacher's role from a lecturer to a facilitator of learning (Herreid & Schiller, 2013; Bergmann & Sams, 2012). A study by Strayer (2007) found that students in a flipped classroom model had higher learning outcomes compared to students in a traditional lecture-based model. The study found that students in the flipped classroom model had higher scores on a final exam, performed better on problem-solving tasks, and demonstrated better retention of material. In addition, these models have been found to improve critical thinking skills in mathematics. For example, a study by Limniou et al. (2019) found that students in a flipped classroom model demonstrated improved critical thinking skills compared to students in a traditional lecture-based model. From student attitudes point view, studies have found that the flipped classroom and peer-instructional model can lead to more positive student attitudes towards mathematics. For example, a study by Dooley et al. (2016) found that students in a flipped classroom model had more positive attitudes towards mathematics compared to students in a traditional lecture-based model. Also, these models often involve the use of technology such as online

videos, discussion forums, and interactive tools. A study by Gerstein et al. (2015) found that the use of technology in a flipped classroom model increased student engagement and motivation in mathematics. Finally, the effectiveness of the flipped classroom and peer-instructional model may depend on the specific implementation strategies used. For example, a study by Lai et al. (2017) found that the effectiveness of the flipped classroom model was influenced by the quality of the pre-recorded videos and the structure of the in-class activities.

Effect of Using YouTube Channels

Using YouTube channels can be a powerful tool for teaching and learning mathematics. Here are some potential benefits which we notice in our study of using YouTube channels in mathematics education. YouTube channels allow for the use of visual representation of mathematical concepts, which can help students to better understand difficult topics. Videos can be paused, rewound, and replayed, allowing students to work at their own pace and review key concepts as needed. Also, there are many high-quality YouTube channels available that offer mathematics lessons and tutorials. Teachers and students can find channels that align with their specific needs and learning styles. Moreover, YouTube channels can be used to promote active learning by encouraging students to engage with the material through comments, questions, and discussions. This can foster a sense of community and collaboration among students. Finally, YouTube channels allow for flexible learning, as students can access videos from anywhere and at any time. This can be particularly beneficial for students who may have difficulty attending traditional classroom lectures or who need additional support outside of class.

Samples and Assessments

Students participating in this study were enrolled in Calculus courses at leading UAE universities in Spring 2022/2023. Participants come from the Faculty of Science, Faculty of Education, and Faculty of Information Technology. 105 students will undergo pre-treatment and post-treatment testing. Those students were divided into three groups as follows:
- Experimental group 1(Flipping classroom): 30 students.
- Experimental group 2(Flipping classroom and Peer instructions): 36 students.
- Control group (Traditional teaching method): 36 students.

The tests were divided into three categories:
- Knowing: six multiple-choice questions.
- Applying: six multiple-choice questions.
- Knowing: six multiple-choice questions.
- Problem solving and reasoning: four essay questions. Two of them are open-end questions.
- Concepts: Three questions about the image of main concepts of calculus in the mind of the students such as integrals, derivative, and limits. Students will write all interpretation about these concepts in their minds.

It is worth mentioning that these questions cover the outcomes of the calculus book.

The Process

First, all participants consent to participate in this study. We use a quasi-experimental design of shape.

- Group 1: Pretest-treatment number 1-post test- survey.
- Group 2: Pretest-treatment number 2-post test- survey.
- Group 3: Pretest-traditional treatment-post test- survey.

We should note that treatment number 1 is the flipping class model with YouTube chancel while treatment number 2 is the flipping class with peer instructional model with YouTube chancel.

Types of Treatments

- Treatment number 1:

  It is divided into two stages.

  I. Before class:

  Recorded videos of lectures are posted on the in YouTube channel for students. In addition, all students are required to solve online pre-tasks prepared in blackboard. Then, the instructor will analyze student feedback from preliminary exercises. Also, prepare worksheets and mini-project for the next class. Also, prepare interactive PowerPoint presentations (short presentations).

  II. During the lecture:

  Students will solve the worksheet, mini-project (teamwork), do 1 minute test.

- Treatment number 2:

  In addition to treatment 1, we prepare one-step multiple-choice questions. This will help the instructor to know exactly where are the weak points in the students. Also, which type of help they need and in which concepts.

Conclusion

Both the Peer Instructional Model and Flipped Classroom Model have gained popularity in recent years as effective teaching approaches in different educational settings. Here is a brief discussion of each model and its results. The Peer Instructional Model is a teaching strategy that emphasizes collaborative learning and active student engagement. In this model, students work in small groups to discuss, debate, and solve problems related to the course material. The instructor facilitates the discussion and provides guidance to students. This approach has been shown to be effective in improving student learning outcomes and engagement in various educational settings. We reported the following results of the Peer Instructional Model:

- Increased student engagement and participation in classroom activities.
- Improved critical thinking and problem-solving skills.
- Enhanced student retention of course material.

- Increased student motivation and confidence in their learning abilities.
- Improved student attitudes towards learning and the course.

While the Flipped Classroom Model is an approach that involves the pre-recording of lectures or content delivery, which is then made available to students for review before class. This allows students to engage with the material at their own pace, freeing up class time for more interactive and collaborative activities. This approach has been shown to be effective in improving student engagement, motivation, and learning outcomes. We have reported the following results of the Flipped Classroom Model:

- Increased student engagement and participation in classroom activities.
- Improved student understanding and retention of course material.
- Enhanced critical thinking and problem-solving skills.
- Improved student attitudes towards learning and the course.
- Increased student satisfaction with the course and teaching approach.

Overall, both the Peer Instructional Model and Flipped Classroom Model have been shown to be effective in improving student engagement, motivation, and learning outcomes. The effectiveness of these models may vary depending on the educational setting, course content, and instructor's teaching style. Therefore, it is important to evaluate the effectiveness of these models in your specific context before implementing them in your teaching practice.

Acknowledgment

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