Plan for a SoTL Project

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Research Question

What are you curious about?
What would you like to know about strategies that might hinder and/or help students to learn, in your course?
Do you want to know if an activity, assignment, or teaching strategy "works?"
Do you have a question about how to help your students learn a particular skill?

Because of its student-centered learning approach, the flipped classroom model has gained in popularity among post-secondary educators as a means to both engage students and improve student outcomes. On the surface, a flipped classroom appears to provide significant benefits to student learning, and aligns well with the skills required of modern learners. But in practice, does a flipped mathematics classroom deliver on this promise? The evidence reported in the literature on flipped mathematics classrooms is mixed and inconclusive. Does flipping the mathematics classroom deliver the improvements in student achievement desired by mathematics educators? Does a flipped classroom increase student engagement in the learning of mathematics? What are students' attitudes and perceptions about learning mathematics in a flipped classroom?

Identify challenge/outcome related to learning that is related to your question.

Describe the learning in a way that suggests how you might *measure* it using either qualitative or quantitative methods.

Challenges:

- Do students have the self-discipline to learn mathematics using a flipped class model?
- Can all of the class activities be prepared well, and in a timely manner?
- How will students respond to learning mathematics in a flipped class model?
    - Will students have positive or negative reactions to the flipped class model?
    - What is the level of student engagement with the material using a flipped class model?

Outcomes:

- Assess student perceptions of the flipped class model.
- Assess level of student engagement with the material using a flipped class model.
- Evaluate changes in student achievement and outcomes using a flipped class model.
- Evaluate faculty workload in preparing a flipped class.

Describe the instructional activity, assignment, or teaching strategy that will promote student learning on the outcome you identified.

SoTL projects might investigate the impact of a *modification* to an existing strategy or assignment. Describe how the new approach differs from the old approach and why this modification might change student learning on this outcome.

The conventional teaching method for most mathematics courses in post-secondary education is the traditional lecture, which is characterized by a teacher-centered learning approach. However, both the needs of students in the 21st century and the essential skills required of college and university graduates are rapidly changing. As a result, many post-secondary instructors are seeking new pedagogical approaches that focus on students, student learning, and the skills of modern learners. One of these pedagogical approaches is the flipped classroom. A flipped or inverted classroom approach is one in which direct instruction moves to the individual learning space as homework, typically by using asynchronous video lectures, and the classroom becomes a dynamic, student-centered learning space With direct instruction moved into the time traditionally reserved for homework, the instructor can use class time with students to promote understanding, apply concepts, and develop problem-solving and critical thinking skills.

In the past, I have approached mathematics teaching in the same way that I was taught—direct instruction with the traditional lecture, followed by homework or quizzes completed outside of class time. I have observed that my students, many of whom either dislike mathematics in general, struggle with the subject matter, or both, completely disconnect and zone out of the class when I use a traditional lecture style. As well, students struggle with after-class homework or quizzes because of both a lack of understanding from the lecture and the inability to get help from me. In an effort to engage students during class time, I would like to implement a flipped class model.

The modifications I would like to make to my class are:

- Before class:

    - Students watch pre-recorded video lectures on the content covered for that class.
    - Students complete a brief, auto-graded, reading quiz on the material covered in the video lectures.
- During class:
    - Together, the class completes a short problem-solving worksheet to review the material from the pre-class activities.
    - Individually, students complete an auto-graded quiz based on the day's material. Although each student will complete their own quiz, students are encouraged to seek help from other students and from the instructor.
- After class:
    - Students are assigned non-graded practice problems.

Flipped classrooms offer many potential benefits to student learning of mathematics, including:

- Development of skills and competencies required in the modern world, such as critical thinking, problem-solving, collaboration, communication, time management, responsibility, accountability, leadership, self-direction, and self-efficacy.
- Improved student achievement and outcomes.
- Multiple opportunities to interact and engage with the material.
- Support of multiple learning styles.
- Increased engagement with, knowledge retention, and understanding of the material.
- Increased opportunities to ask questions and receive instructor feedback.

There are some limitations to the use of the flipped class model:

- Unfamiliarity and inexperience of students in learning mathematics with the flipped class model.
- Inability of students to ask questions during the pre-class activities.
- Increased faculty workload to develop the required resources.
- Requirement of students to be good independent learners.

Describe the evidence that would persuade an external audience that the new or modified teaching strategy improves student learning on the targeted learning outcome.

Describe the evidence you would need to collect to answer questions about the impact or value of this teaching strategy. How would you convince others that this approach is better than other approaches? What comparisons should you make? Examine students; skill before and after the assignment? Compare students who complete the learning activity to another group of students – what comparisons would be meaningful?

Quantitative Evidence:

- Compare grades from students in non-flipped classes to flipped classes, ideally taught by the same instructor.
    - Are the grades for the students in the flipped class better than the grades for the students in the non-flipped class?
    - Are the results statistically significant?

Qualitative Evidence:

- Surveys of students in the flipped class model.
    - What are students' perceptions of the flipped class at the start of the semester? What are students' perceptions of the flipped class at the end of the semester?
    - How would students rank their level of engagement? Did they experience more or less engagement with the material compared to previous mathematics courses?
- Interviews with students about their experience with the flipped class model.

How and where would you publish, present, or disseminate this work?

- Presentation at the annual Ontario Colleges Mathematics Association conference or conferences related to the scholarship of teaching and learning.
- Paper in a journal focused on teaching and learning of mathematics or the scholarship of teaching and learning.

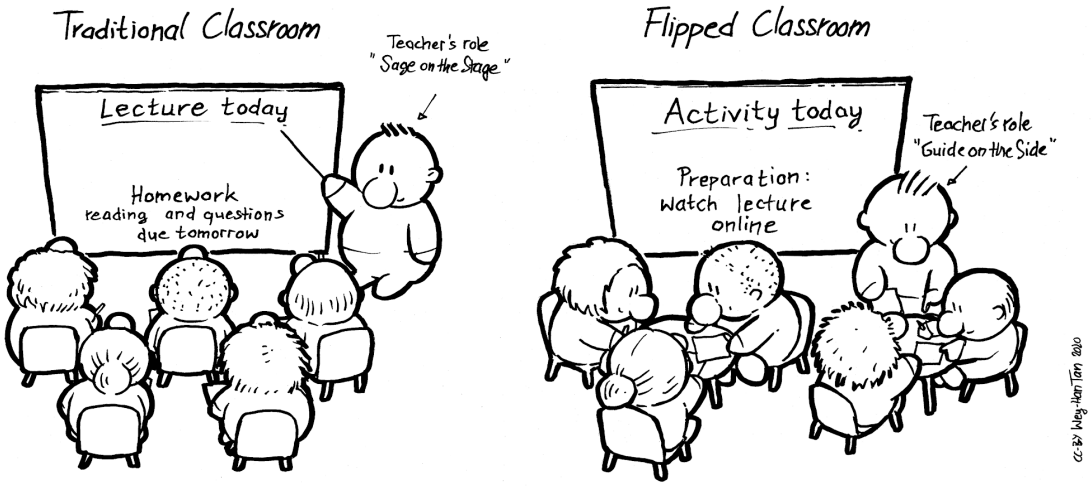
Ethical Considerations

This research would require the collection of information about and from students, such as data on grades, responses to surveys or questionnaires, or interviews. Steps will be required to ensure ethical practices involving research on human subjects are followed, including:

- Obtaining approval from the school's ethics committee to ensure the procedures used meet the ethical standards of conducting research that involves human subjects.
- Obtaining permission from the school to conduct research on site.
- Obtaining consent from individuals who participated in the study.
- Ensuring that the procedures do not harm the participants.
- Protecting the anonymity of the participants.

Final Reflection

I have reviewed a lot of the recent literature about flipped mathematics classrooms. In fact, I wrote a paper on the impact of flipped mathematics classrooms on student learning for one of my Master's degree courses. Much of the research appears to be inconclusive about both the effectiveness of using flipped classrooms to improve student outcomes and increased student engagement within the mathematics classroom. Does a flipped classroom really improve student outcomes in mathematics, or is this just wishful thinking on the part of educators? At this point, I am on the fence about the effectiveness of a flipped classroom to improve student outcomes, partly because of the research I have done on flipped classrooms, and partly because of my own experience in using a flipped class model. Recently, I have used a flipped classroom in some of my courses. Anecdotally, I have observed a slight improvement in student outcomes. But I did not see huge increases in overall student achievement. Although I did not perceive a drastic change in outcomes for my students in my flipped classes, I definitely saw increased engagement from my students. However, the biggest challenge with using a flipped class model is getting students to complete the pre-class activities. Many of my students come to class without doing the pre-class work, which I believe limits the effectiveness of the flipped class model. In the past, I have not attached a grade to the pre-class activities, but a grade appears to be the only way to force students to complete the pre-class work. Despite these challenges, the increased engagement alone is enough to convince me to persevere with the flipped classroom model.



Note. From *'Flipped Classroom Drawing'* [Image], by Wey-Han Tan, 2020, WikiMedia Commons (https://commons.wikimedia.org/wiki/File:FlippedClassroom_Drawing_WeyHanTan_CCBY2020.png). CC BY-4.0

References

Tan, Wey-Han. (2020, October 6). *Flipped Classroom Drawing* [Image]. WikiMedia Commons. https://commons.wikimedia.org/wiki/File:FlippedClassroom_Drawing_WeyHanTan_CCBY2020.png.

Adapted from: C. J. Stanny, E. M. El-Sheikh, & H-M. Chung (2009) ***Getting Started with a SoTL Project***
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