

Flipping Calculus I

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Rationale:

Calculus provides the foundation to physics, engineering, and many higher math courses. It is also important to chemistry, astronomy, economics and statistics. Majority of engineering, chemistry, biology, math, and health sciences majors take Calculus fairly early in their college study, and it is considered a gateway for other courses. Therefore it is crucial for students to deeply understand the concepts in Calculus and be able to apply them to related problems in their field.

In traditional math classes, the professors do the lecture and the students listen and take notes, participating in what educators call “passive learning”. Outside of class, they do readings, review their notes, and do their homework. If they have questions, they may try to puzzle things out with a classmate. Asking questions in class can be embarrassing. Actually talking to a professor during office hours is a last resort.

Flipping the classroom refers to changing the traditional use of in-class time. In this inverted model, instruction happens outside of the classroom in the form of recorded lectures or short video, while class time transformed into a workshop where students analyzed data and solved problems together. Students benefit more from this method. They do “active learning”.

Description of the Project:

In the flipped Calculus class, students will be asked to watch short videos prepared by instructors and complete an online quiz before coming to class. During the class, students will solve problems with their professors or peers, and apply what they learn to new contexts. They continue this process on their own outside class. The whole class will be divided into five to seven working groups. Each group will be equipped with an iPad. The iPad can be used to perform data analysis, mathematical calculations, graph visualization, using mathematical software, for example, WolframAlpha, record group progress, and exchange ideas between groups. Students’ progress will be monitored by instructors and assigned problems will be collected and graded.

Depth of Impact:

With Flipped teaching methods, students change from “passive learning” to “active learning”. Instead of just copying lectures from blackboard, they will involve every step of the problem solving process. They will discuss with their classmates and the instructor. They collaborate with each other and learn from each other. In our regular teaching classes, there are too many instances of students saying “It makes sense when you do it but not when I do it”.

Breadth of Impact:

Calculus I is a required course for all science majors. It is also required for computer science, health science and engineering department. In Spring 2014, we have seven sections of Calculus I. Each section has approximately 30 to 36 students. In any regular semester, we have approximately 180 to 250 students are registered to take Calculus I.

Description of the innovation:

The project will change the way Calculus I is taught. It will engage students more in the learning process and give them a positive learning experience. The flipped Calculus class can impact the way students think about mathematics and can attract more students to the STEM field.

Students will be able to solve complicated and multi-step problems, and they will be able to communicate using proper mathematical language. Students will have deeper understanding of the math content and they will gain positive interdependence. Students will fully participate and put forth effort within their working group. Flipped class learning also increases students’ effective communication, interpersonal and group skills.

Preliminary Evidence:

Many colleges and universities give a lot of support and funding for instructional improvement for Calculus. In spring 2012 a core group of six faculty from the Mathematics Department of University of Hartford applied for a National Science Foundation (NSF) grant, “Flipping Calculus,” which they received in spring 2013. The grant was used for expanding the department’s library of course material, preparing more faculties in the department to use this approach, and assessing the method’s effectiveness.

In Fall 2013, Department of Mathematics of University of Hartford has received national attention as one of the most successful in the United States based on a survey of undergraduate Calculus I courses by the Mathematical Association of America (MAA).

Implementation:

Starting from Fall 2014, we plan to teach two sections of Calculus I (MATH 1210) as a flipped class. Each course has approximately 30 to 36 students.

Assessment plan:

We evaluate the outcome in the following ways:

1. Headcount: Count the number of students registered for the class, and the number of students who attended the final exam.
2. Statistical data from Canvas: Students' online attendance, online discussion, and completion of online quizzes.
3. Student evaluation: We can conduct a survey from students about their leaning experience attending this class. Some types of question can be surveyed as following:
 - a. If you have a chance, would you take a flipped class or a regular class?
 - b. Were the online videos helpful?
 - c. Did you feel that the class time used efficiently?
 - d. What was the most effective aspect of this flipped class?
 - e. What was the least effective aspect of this flipped class?
4. Learning outcome assessment: We can track student's homework and exam performance. We can compare completion and passing rates of students attending the flipped class with students in regular class.

Sustainability:

In the future, we would like to extend this teaching method to not only to other sections of Calculus, but also to other Math and Statistics courses. We also plan to apply for external funding to expand this program.

Detailed Budget:

- Travel to visit Department of Mathematics of University Hartford to learn from their success and exchange new ideas.

Airline ticket for two people: $480 * 2 = \$960$

Hotel for 4 days: $120 * 4 = \$480$

Transportation: \$100

Per diem: $40*4+40*4=320$

- Travel to attend MAA (Mathematical Association of America) Math Fest, Portland, Oregon, August 6-9, 2014. MAA Math Fest is the largest annual summertime gathering of mathematicians and Math educators. In the teaching sessions of this conference, there are a lot of talks about innovative teaching methods for various math courses.

One person: Airline + registration + accommodation = \$1500.00

- Laptop: MacBook Pro, 13-inch: 2.4GHz, 512GB. For recording, editing, and storing lecture videos \$1499.00
- Gamtasia (software): Camtasia is a software to record on-screen activity, lessons, or presentations. Import media and customize the recordings into engaging videos.

\$74.00

- Camera: To record lecture: Canon VIXIA HG21 \$399.00
- Tripod: \$45.00
- iPad for students' group: $6*399=\$2394$
- Stipend: Two Instructors will record and edit lecture videos, prepare online materials: quizzes, assignments, and group works in Summer 2014.

$\$3000*2 = 6000.$

Total: \$13,771.00