Activity

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Written Course Project

Educator: Joe Skufca, Professor and Chair of Mathematics Department
Context: In-class and out of class; Calculus I and II sequence course projects
Keywords: design projects, teams, connecting learning, written reflection, communication
Student Activity Time: 6+ hours outside of class

In small groups of 2-3, students worked on a course project in which they reflected back on class learning, synthesized that learning to explore an assigned problem area, and reflected on their project.

Introducing the Reflection Activity

In the Calculus sequence course (Calculus I and II), first- and second-year students worked in small groups on two course projects. The purpose of the course projects was to support students in reflecting on their class learning, synthesizing that learning, applying the learning to problems, and reflecting on their learning in the course project.

At the beginning of the course, the educator introduced the course projects, the purpose of them, and how to write the associated reports. In the projects, students drew on their class learning to respond to a scenario with real (preferred) or realistic data that required them to use the mathematics they learned in the course. After completing the math portion of the course project, students reflected on the following questions:

1. What are the sources of error in the computation?
2. Would the answer get more accurate if you had more data?
3. Is there a limit to the accuracy that you might achieve by taking more data?
4. Can you make a "back of the envelope" estimate of the problem to see if your answer is reasonable?

The purpose of these reflective questions was to guide students through reflecting back on their mathematical computations represented in their course projects.

The projects were a required component of both Calculus I and II, accounting for between 10-15% of the overall course grade. After students submitted the projects, the educator graded the course projects using a numerically scored grading rubric that balanced the emphasis of technical correctness, communication, and analysis. The letter scale associated with the numeric outcome was such that an "A" paper may have still lost several points, allowing the grader to document where improvements could be made, while still validating the students work. [This difference is important because almost certainly, even the "A" students have never had experience with technical writing]. After graded projects were handed back to the students, the educator debriefed the class on highlights from the course projects.

In terms of outcomes, often students come away from the course with a better appreciation for the importance of math. This project helps students see the benefit

and potential usefulness of math. As well, it has the potential to expose students to creativity and the connection of creativity and math. The project also requires students to examine a problem at a broader level—revisiting the problem with a different perspective. The communication step is crucial: when we are forced to explain something – especially in writing – we must really grapple with identifying the critical components of the argument, and how the "pieces" fit together.

Recreating the Reflection Activity

	Description
1	Create a course project that has a technical component and a reflection component. This approach will guide students through a project, project write-up, and reflection of the project.
2	Introduce the project to the students.
3	Grade the project using detailed rubric, which allows the students to better understand how to improve. A flexible "grade" scale will allow documenting where students may improve while still rewarding good (but inexperienced) students.
4	Debrief students on what you saw in the course projects.

In the words of the Educator: Tips and Inspiration

Create open-ended problems. Try to ensure there is enough open-endedness in the project scenario, so there is no inherent wrong answer to the problem.

Provide a balance of guidance and challenge. I believe it is important to provide students with enough guidance, so that they have a framework to get them started. However, it is also important for the project to be challenging to them. The project should balance guidance and challenge.

Provide extra guidance for students who need it. It is important to provide structured opportunities for students to receive help from TAs or me.

Arrange for more help with grading. If it is possible, get more help with grading—that would be really helpful. With more help, you can provide students with more valuable written feedback.

Record and document improvements of the project. As you are working with students on the project, it can be beneficial for you to keep track of how the project is going—things that are tripping students up, things that make sense to students, etc. This documentation is helpful as you use the project the next time you teach the course.

What was the inspiration for the activity? When teaching Calculus II with Professor Kate Fowler at Clarkson, she mentioned her projects in Calculus III. She thought that it would be a good idea to integrate projects throughout the entire calculus sequence.