

# Understanding Student Perspectives on Their Self-Efficacy and Learning Experiences

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## Abstract

Students' self-efficacy, their confidence in their ability to complete a task, is a good predictor for student success and persistence. Previous research indicates that improvements in learning methods can enhance self-efficacy and that classroom dynamics allow for different self-efficacy opportunities that may impact students' self-efficacy. In this study, we analyzed interviews from 12 students enrolled in a flipped integral calculus course to understand their perceptions of self-efficacy and how these perceptions were affected by classroom dynamics and activities. We found three self-efficacy opportunities mentioned in the interviews: mastery experience, vicarious learning, and verbal persuasion. Preliminary findings reveal that experiences in previous math courses, particularly high school, impacted students' perceptions of their self-efficacy in math both positively and negatively, active learning activities increased students' confidence in their ability to do math from their perspective, and verbal persuasion increased students' confidence and was seen as helpful in learning.

## Course Structure

- Pre-class video set
- In-class review & technology demonstration
- Online quiz on video set
- Rotating stations led by LA and instructor
- Online quiz on WebAssign & video set
- Finish any remaining problems, begin next set

## Coding Scheme

Category	Code	Description
Activities mentioned	A1: A1g; A1n; A1b	In class activity: good; neutral; bad experience
	A2: A2g; A2n; A2b	Out of class activity: good; neutral; bad experience
Confidence	C1: C1g; C1n; C1b	Increase in confidence: good; neutral; bad experience
	C2: C2g; C2n; C2b	Decrease in confidence: good; neutral; bad experience
Feelings toward or about math	F1: F1g; F1n; F1b	Positive feelings described: good; neutral; bad experience
	F2: F2g; F2n; F2b	Negative feelings described: good; neutral; bad experience
	F3: F3g; F3n; F3b	Neutral feelings described: good; neutral; bad experience
Courses mentioned	M1: M1g; M1n; M1b	College or university course: good; neutral; bad experience
	M2: M2g; M2n; M2b	High school course: good; neutral; bad experience
	M3: M3g; M3n; M3b	Middle school or elementary school course: good; neutral; bad experience
Self-efficacy source	O1	Mastery Experience
	O2	Verbal Persuasion
	O3	Vicarious Learning Experience

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## Background

Self-efficacy is the belief one has in their ability to complete a task, and it can affect one’s willingness to try new or challenging tasks. Previous studies in self-efficacy have shown that male and female students benefit from different sources of self-efficacy. The course studied was integral calculus, over 8 weeks in the summer of 2018. The class met three evenings each and was held in an ”Active Learning Classroom.” The students in the course were mostly incoming sophomores and juniors, and many were retaking the course. In the flipped class model, students worked through video tutorials at home. Each 2hr 45min class session was made up of time spent at two or three rotating stations, working through WebAssign, workshops, and any other material with the professor or the learning assistant.

The sources of self-efficacy we are looking for are:  
**Mastery experience** (successful completion of a problem, homework set, exam, etc.)  
**Vicarious learning experience** (watching someone else work through or complete a problem)  
**Verbal Persuasion** (implicit encouragement from a teacher, learning assistant, classmate, etc.)

## Coding Example

### Qualitative 1st Analysis Example

**Interviewer:** Okay. Thank you. You actually answered the follow up question, but I'll ask anyway in case you have something else you want to add: which is, how did this impact your mastery of math classes, that experience?

**Interviewee:** Um, I think it just kind of taught me to take math more seriously. So, I guess in high school I never really, like I didn't really study as hard as I, like for what I like deserved to get, I don't think it was like even, like I probably deserved worse than I got, where in university I learned that's not the case like they're really, if you're unprepared you'll get a bad grade and that's just how it works.

### Qualitative 1st Analysis Example

**Researcher 1: yellow**  
**Researcher 3: pink**  
**Researcher 1 and 3 overlap: orange**

**Interviewee:** Um, I think it just kind of taught me to take math more seriously. So, I guess in high school I never really, like I didn't really study as hard as I, like for what I like deserved to get, I don't think it was like even, like I probably deserved worse than I got, where in university I learned that's not the case like they're really, if you're unprepared you'll get a bad grade and that's just how it works.

### Final Rounds of Coding Example:

Ok. So, I guess, in high school, I was like, very much like, top of the class, like worked really hard and everything, so math like really came easy to me my whole life. So, I was a good student, I would always study, make sure like grades were on top of it, and now like I came here, like, it's very much like a wakeup call. So, I mean now like I know it's like people like, my professors have talked to me about like, possibly having like math anxiety, now, and stuff, so it's definitely like now I feel like I kind of avoid it a little bit more, but um, yea, it's like definitely different for me now.

### Qualitative 1st Analysis Example

**Researcher 1: yellow**  
**Researcher 2: blue**  
**Researcher 1 and 2 overlap: Green**

**Interviewee:** Um, I think it just kind of taught me to take math more seriously. So, I guess in high school I never really, like I didn't really study as hard as I, like for what I like deserved to get, I don't think it was like even, like I probably deserved worse than I got, where in university I learned that's not the case like they're really, if you're unprepared you'll get a bad grade and that's just how it works.

### Qualitative 1st Analysis Example

**Researcher 2: blue**  
**Researcher 3: pink**  
**Researcher 2 and 3 overlap: purple**

**Interviewee:** Um, I think it just kind of taught me to take math more seriously. So, I guess in high school I never really, like I didn't really study as hard as I, like for what I like deserved to get, I don't think it was like even, like I probably deserved worse than I got, where in university I learned that's not the case like they're really, if you're unprepared you'll get a bad grade and that's just how it works.

## Qualitative Methods

- 12 Post-class interviews
- Transcribe interviews
- First round of coding (open coding, broad words/phrases)
- Condense into loose categories
- Collapse categories into themes
- Write interview protocol
- Second round of coding per protocol, using Nvivo (in progress)
- Calculate inter-rater reliability
- Third round of coding if necessary
- Determine themes across interviews, verify preliminary findings

**Research question:** How does the self-efficacy of math/physical science students in a flipped Calculus 2 course change over the course of one semester?

### Interview questions:

1. Tell me a story that explains something about the type of student you are in math. In other words, share with me something that happened to you that involves this subject and perhaps your parents, teachers, or friends.
  - a. How did this impact your mastery of math classes?
2. Describe the best teacher you’ve had in math. What made her (or him) so good?
3. Think about how math makes you feel. You probably haven’t been asked to think about that before. When you are given a math test, how does that make you feel? How do you feel when you are given a math assignment?
4. Earlier you rated your math ability on a scale of 0 to 9. How would you rate your confidence in math now? Why?
5. What could make you feel more confident about yourself in math?

## Findings & Future Work

- 11 out of 12 students rated their confidence in math higher at the end of the course compared to before the course began.
- Experiences in previous math courses, particularly high school, impacted student perception of their self-efficacy in math both positively and negatively
- Active learning increased students’ confidence in their ability to do math from their perspective
- Verbal persuasion (implicit encouragement) increased confidence and was seen as a good way to learn.

In the fall of 2019, all 27 sections of Rutgers’ Pre-Calculus for Engineers course were reorganized to the flipped format of this pilot study course.

I hope to continue research into self-efficacy in graduate school, exploring how it ties in with physics identity and retention of women and ethnic/racial minorities in physics.

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