

Student attitudes in first-semester Calculus

David M. Bressoud

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Abstract

One of the large lecture sections¹ of first-semester calculus at Penn State was surveyed to determine student attitudes toward calculus and the learning of calculus. This is a summary of the picture that emerged. The student described here is not entirely typical: only half of the students were in class that day. 91% of those who answered this survey reported that they regularly attend class. This is therefore a picture of the conscientious student who comes regularly to class. It says nothing about the student who does not come to class.

I have chosen to give this conscientious student a name: Chris.

Chris is a science or engineering major in the first semester of the freshman year and is by definition a good student who did well in high school. Chris has always liked math,² feels confident about the ability to handle it,³ and believes that it will play an important role in the chosen major.⁴ Especially appealing is the precision found in mathematics and the sense of satisfaction that comes from getting an exact solution to a problem.⁵ Chris took an Advanced Placement calculus course in high school last year,⁶ but entered Penn State feeling insecure about the ability to use calculus. Expecting that it will provide an important foundation for later courses, Chris began this class looking for a better understanding of the topics that were studied the previous year.⁷

Having had an AP calculus class the year before, all of the topics covered in first-semester calculus, and some of those in second-semester calculus, are familiar. Nevertheless, Chris comes to all or almost all of the lectures.⁸ The

professor spends the first half of the period talking about the theory involved in the topic at hand, and then moves into examples of problems that are based on this theory.⁹ The material is projected onto a screen using transparencies, many of which are prepared beforehand. Being conscientious, Chris strives to write down everything that is projected. Because the concentration is focused on getting everything written down, there is little time to listen or try to make sense of what is being said.¹⁰ Chris will not ask questions;¹¹ the large lecture is simply too intimidating.¹² Not all of the other students are working as hard. Many in the back are talking, and some are sleeping.¹³

Later that same day,¹⁴ Chris sits down to study calculus. This means doing the homework problems.¹⁵ Chris is conscientious, doing every problem that is assigned,¹⁶ but feeling frustrated by the even numbered problems for which there are no answers in the back of the book.¹⁷ The homework problems are worked alone, but sometimes Chris will discuss the most difficult ones with friends who are taking or have taken this course.¹⁸ When doing the homework, Chris initially relies on what is remembered from last year. The next recourse is usually the notes from that day which are used to find examples of similar problems. Such examples are often helpful, but the notes from the theory part of the day's lecture make little or no sense.¹⁹ The third recourse is the book which is searched for worked out examples.²⁰ Chris will spend about an hour working on the assigned problems that relate to that day's lecture.²¹

Once a week, there is a lab session that uses graphing calculators. To Chris, this is a mechanical exercise that is required but seems to bear no relationship to the rest of the course.²² It would be much more helpful to go over the homework problems.²³

There are two midterm examinations given on Wednesday evenings. Serious study begins the weekend before the exam.²⁴ This means putting in 2-3 hours a night up until the time of the test²⁵ redoing homework problems, working the practice exams, going over notes, and sometimes looking through the textbook.²⁶ The theory that was explained at the beginning of the lectures is unimportant because it never appears on the exams.²⁷ There is a good deal of frustration after the test because the exam questions are not quite like the homework questions,²⁸ and it does not seem that the instructor has tested what Chris has studied. The fact that the exams are multiple choice with no partial credit and that each exam counts for such a major portion of the grade reinforces a sense that the purpose of the exam is to

trap and fail as many students as possible.²⁹

Chris is becoming increasingly cynical about the importance of calculus. There has been no sign that it is actually useful for anything.³⁰ Maybe calculus really is just a “weedout course.”³¹ Chris had arrived at Penn State hoping to begin to understand calculus. Instead, it has become more confusing than ever. There seemed to be more emphasis on concepts and understanding in high school than is being found at the university.³²

Endnotes

1. Initial enrollment was 350 students.
2. On a scale of 1–10, 87% of respondents rated how much they like math as 7 or higher, 63% rated it as 8 or higher.
3. 58% of respondents felt that they could discover some mathematics on their own. Only 33% were certain that they could not.
4. Among the most common responses to “How is calculus used?” were that it is used in engineering, physics, science, or higher mathematics.
5. This was the most common response to the question “What do you like about calculus?” Typical answers were “I like calculus because, as in all math, it has definitive answers.” “I like calculus because it is like a puzzle. If you know how to play or figure it out—you win.” In a related vein, many students like the algorithmic nature of mathematics: “I like how it is very methodical and tedious.”
6. 89% of respondents had taken calculus previously; of these, 53% took Advanced Placement calculus in high school.
7. The most commonly given answer to the question “What do you expect to get out of class?” was “better understanding of calculus.”
8. As stated above, 91% of respondents come regularly to class. Many of these emphasized that they have never missed a class.
9. This summary of what happens in the classroom is based on the respondents’ descriptions.

10. 95% of the respondents said that they take notes in class; 43% said that they listen, pay attention, watch, or try to understand. A typical response was the student who said that “the prof gives notes and does a few examples. Most students pay attention and try to take notes, but he moves quickly. I usually end up behind and start doodling.”
11. 85% of the students never ask questions in class.
12. “Very rarely [ask questions in class]. The atmosphere is not conducive to interaction between lecturer and student. It’s just too big.”
13. These were common responses to the question “What do other students do?”
14. 55% of the students will do the homework relevant to a given lecture either before or on the same day as the lecture. An additional 24% will do the homework problems within one week of the lecture.
15. 90% said that when they study they do homework or practice exam problems; 22% go over their notes; 17% go over the book.
16. 66% of respondents do all of the assigned problems. Homework is not collected or graded.
17. A common complaint is expressed in the comment “On the syllabus, there are quite a bit of even problems assigned. This is pointless, especially when the answers to such problems are posted one week later. You need to know if you’re doing the homework right *as you do it*, *not* one week later. Either assign more odd problems or give us the answers to the even problems sooner.”
18. 56% study alone, although many of these will sometimes get help from or help others. An additional 27% will sometimes study alone and sometimes study with others.
19. Some of the comments were “I try to use [the notes] to figure out homework, but a lot of the notes seem like useless information.” “I rarely read the notes, unless I have a problem with one of the homework problems.” “I always take notes! I read them but they make no sense.”

20. “[I use the text] when my notes fail to make sense. The text doesn’t provide too much help either, it’s written so technically that it’s almost like reading a foreign language.” “You must filter out what is important and what is just to confuse you.”
21. 55% of the students normally spend 2–4 hours a week studying calculus. Half of the remainder spend less than 2 hours, half over 4 hours. Students who have not had calculus before will spend about twice as much time.
22. Asked to describe a typical lab session, 66% of the respondents said things like “I do the lab, then I leave.” 29% were more negative: “We get worksheets that make no sense and put down answers that we don’t understand.”
23. There was no question on the survey that addressed this issue, but it was one of the most common complaints.
24. 48% start studying at least 5 days before the exam, another 26% start the weekend before the exam.
25. Before an exam, students average an extra 9 hours of studying.
26. As reported above, 90% said that when they study they do homework or practice exam problems; 22% go over their notes; 17% go over the book. Few students distinguished between “studying” and “studying for a test.”
27. “I try to take notes and pay attention but it is very hard to [do] so because the material is not always necessary to do well on the test.”
28. Several students complained that the tests bore no relationship to the homework and seemed to be based on memorized tricks rather than on understanding.
29. These were common complaints about the course.
30. This was the second most common response to the question “What don’t you like [about calculus]?”: that it is not useful for anything. The most common response was to describe one or more specific topics such as volumes of solids of revolution.

31. A term used by several students.
32. When asked to describe the difference between high school and university mathematics, 32 respondents talked about the quality of explanations, the emphasis on concepts, the familiarity of the instructor with the material, the requirement of more thought and deeper understanding. 81% felt they got more of this in high school; 19% said that they got more of it in college.