Teaching Statement

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Teaching is an opportunity to share my appreciation of mathematics with my students, and convince them that they might enjoy it just as much as I do. My broad goals as an educator include the following:

- Enhance students' impression of mathematics as a whole;
- Emphasize a growth mindset – mathematical ability is not innate but develops with practice;
- Develop students' ability to communicate mathematics effectively;
- Encourage and facilitate independent learning and exploration.

The following are a few teaching practices that I believe support the above goals and others, with some examples of how I have utilized these techniques. At the end of this statement, I have appended summaries of student evaluations from the seven complete courses that I have taught so far.

Engaging students in active problem-solving. I believe that we internalize new concepts best while working on problems. In introductory courses like calculus, I periodically distribute questions for students to explore in small groups. This creates an opportunity to practice a newly introduced technique in class itself where feedback and guidance are readily available. Collaborating with their peers often requires students to describe their thoughts in new ways which enhances their understanding of topics and develops the ability to communicate mathematical ideas. Consequently, instead of passively witnessing a lecture, students become active participants in class and begin to take ownership of the concepts being discussed.

In my current course on topology, in most class periods I invite students to give a proof of a particular statement that I write on the board. We start with a minute or so for students to think on their own before I ask the class for comments or ideas. Together we construct a proof with contributions from multiple students. In this process, one of my goals is to tease out what students are actually saying and work with them to translate their suggestions into mathematical language. Once an idea is proposed, we evaluate as a class whether it might be relevant to the statement we are aiming to prove, modeling what they might do when proving things independently.

Throughout my teaching, I consistently emphasize the process by which we get to a solution more than the solution itself. Through the above activities, students learn that doing mathematics is not about immediately knowing the right answer, but rather an iterative and creative approach towards solving problems.

Promoting mathematical dialogue in multiple formats. My courses frequently incorporate elements intended to develop the ability to communicate mathematical ideas. Students in my honors algebra course independently explored a topic of their choice to give 20–minute presentations to their classmates at the end of the semester; they also wrote short papers that were graded on both content and exposition. Since most of the students had never had a written or oral assignment in a math class before, I created several low-stakes opportunities for them to practice presenting and writing, and receive constructive feedback from multiple sources. Each student gave 2–3 short in-class presentations, evenly spaced over the semester, which were graded only on participation. This was designed to reduce their anxiety of public speaking and familiarize them with a presentation setting. Each speaker received anonymous feedback from their peers as well as myself. Students evaluated their peers' presentations using rubrics, which also gave them a concrete framework within which to evaluate their own performance.

In order to assist students with developing writing skills, I graded their problem sets on both content and exposition. For their papers, I worked with students to choose topics that were appropriate for the course as well as of interest to them; topics were due in the middle of the semester to give them ample time to work on their papers. A first draft was due a few weeks before the final deadline and was returned promptly with comments. In my current topology course, which requires a final paper, each problem set contains a question where students have to read a given topic or section on their own and answer a related (often straightforward) question – the objective is to help students become confident in their ability to learn independently in preparation for researching their papers. From the evaluations for my honors algebra course: "It was good to practice giving lectures on math (as I hope to one day do so professionally), and writing the paper was both enjoyable and enlightening [...]"; "She [...] pushed her students to go above and beyond the typical standards of math classes by mandating self-directed study."

Changing student impressions and attitudes. One of my goals in each course is to positively affect my students' perception of mathematics. This is particularly relevant in an introductory course where many students believe that mathematics consists entirely of rote learning of arbitrary rules. In such a course, I consciously frame our work as problem-solving – a creative enterprise rather than a mechanical one. I make a point to describe the history and reasoning behind why mathematical terms are defined as they are, emphasizing that mathematics is not immutable but rather built, refined, and corrected over time.

Students in my current topology course have the opportunity to attend a department colloquium (on any topic) for extra credit. This is a chance for students to see what contemporary mathematics looks like, and for many students this will be the first formal mathematics presentation they have ever attended. Additionally, I will end the semester with a series of guest lectures by topology graduate students discussing their research, to give students a glimpse of what graduate school in mathematics might consist of.

From personal experience I believe that if an instructor is excited about a subject, students will be more invested in learning it themselves; as a result, I let my enthusiasm for mathematics show, and my energy at the blackboard sets the tone for each lecture. Interacting with an approachable instructor also goes a long way towards combating students' math anxiety and makes them comfortable with asking questions. From evaluations for a calculus course: "I [...] consistently felt in class that my views of math as a subject evolved"; "She clearly loves math, and this shows in the form of her math jokes and excitement when teaching. Her interest in it is infectious"; "Math is also not my favorite subject but she made it seem interesting to me."

Tailoring courses to students. Students are significantly more engaged in a course if they believe it is relevant to their own interests. In order to calibrate each course to its students, I begin each semester with a short survey where students describe their background in mathematics and their reasons for enrolling in the course, both of which can vary greatly. The information I receive informs my choices throughout the semester. For example, in a calculus course with several engineering majors I made a point to give varied examples of real-world applications. If such a class had a large number of biology majors, I would draw examples from population dynamics, disease propagation, etc. From the course evaluations: "For an engineering major, examples and applications of concepts are very important to me, and Aru definitely gave many of those".

In more advanced courses, my students have chosen their own topics for papers and presentations, enabling them to explore a field that interests them on their own terms, in preparation for independent pursuits in the future. In my honors algebra course this approach led to papers on category theory in theoretical computer science, the monster group and the moonshine connections,

cryptography, etc. A third of my current topology course is devoted to topics that students choose by vote. As a result, we will cover fixed point theorems and their applications to economics and game theory (voted on by several economics majors in the class), dynamical systems and chaos, knot theory, etc. This process affirms that each student's interests matter, fostering a sense of inclusion and belonging in the class.

Creating opportunities for feedback. A course is successful to the extent that the students get something out of it, which we can determine by asking them for feedback. However, giving feedback is worthwhile for students only if it improves their learning experience. Therefore, in addition to the standard evaluations at the end of the semester, I periodically conduct anonymous midterm evaluations; students are generally more forthcoming about their comments mid-semester since they can themselves benefit from a solution. The day after receiving midterm feedback, I discuss them in class – addressing concerns and discussing how I intend to respond to them. In addition, I host an online form where students can anonymously send me feedback for any ongoing course. Through these avenues, my goal is to maintain a continuing dialogue with my students where they are comfortable in expressing what they need and to reinforce their sense of agency. From evaluations for a calculus course: "Although this class has very difficult material, the Aru's ability to listen to our feedback throughout the semester made it very easy to handle and even enjoyable."

Facilitating student engagement. The key to engaging students is to strengthen their sense of belonging. The greatest hurdle for many students in a math classroom is their preconceived notion that they are not a 'math person', often due to not matching the race or gender of a 'typical mathematician'. To counter this thinking, I consistently focus on a growth mindset which supports the principle that mathematical ability is built over time rather than some sort of genetic gift. By tailoring courses based on responses to surveys and student feedback, I aim to assure each student that they are a valuable member of the class and bolster their sense of agency. Exploring problems in small groups eases the pressure of speaking out in class while students also realize that their peers are struggling with the material just as much as they are, building a sense of community. When I invite a class to provide a proof for a given statement, I deliberately give them a minute or so to think on their own before I start the discussion; this process gives introverted students a chance to gather their thoughts before needing to verbalize them. Using multi-faceted assessments such as papers and presentations gives an opportunity for students to excel in the activities most suited to their diverse skill-sets. Throughout my teaching, my objective is to convince each student that they have the capacity to excel in mathematics.

The above is an incomplete but growing list; while I have omitted describing some of my current practices due to the need for brevity, I am also constantly adding to my pedagogical toolbox. As a postdoc at Brandeis University, I regularly participate in workshops organized by our Center for Teaching and Learning, including the current Faculty Learning Community on the scholarship of teaching and learning. Earlier, at Rice University, in addition to participating in such programs, I was the graduate student representative on an advisory committee to our newly founded Center for Teaching Excellence.

As an undergraduate at a liberal arts school I saw firsthand the positive and profound effect that dedicated professors can have. I personally started college as a biochemistry major convinced that math was just a tool for other fields, just like many students in introductory courses that I have now taught. I was fortunate to have fantastic teachers who spent countless hours talking to me about mathematics for no good reason beyond their sincere love for the subject; I continue to strive to follow their example.

Summary of Teaching Evaluations

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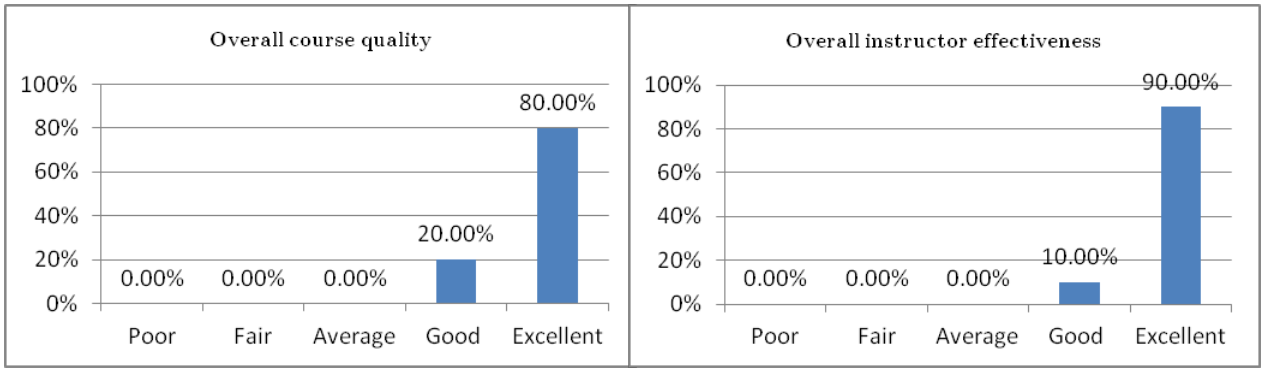
MATH 104a: Introduction to topology, Fall 2015 (Brandeis University)

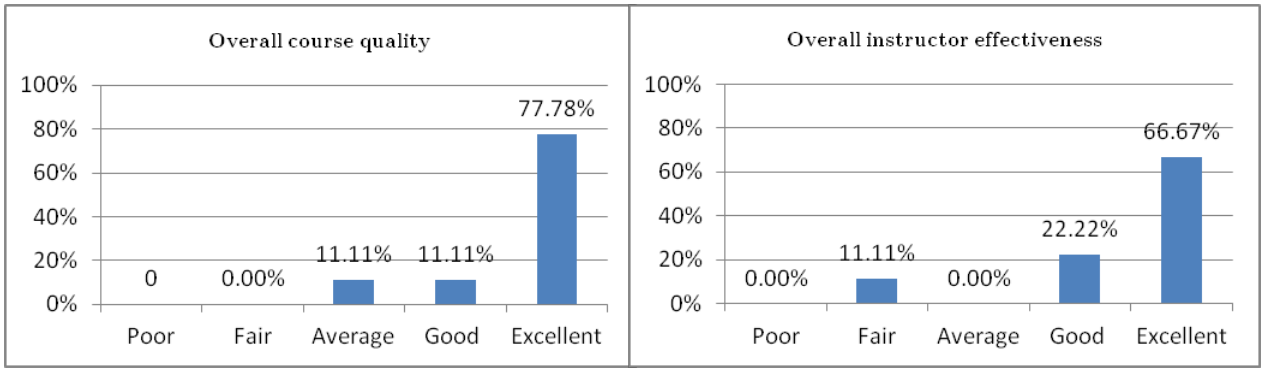


Responses: 10; Enrolled: 10.

Selected comments

- Aru is by far the best professor that I have had at Brandeis. [...] the course was simultaneously my most challenging course and also the most interesting. I truly looked forward to attending lectures and wrestling with the problem sets every week.
- There was a coherence and flow to every topic [...]. There was clearly thought and effort put into how lectures and textbook readings would complement one another.
- There was obvious effort to engage students in dialogue and construction of proofs which is tremendously helpful, and unfortunately not often implemented in math classes.
- I deeply appreciated the distinction between problem sets– which could be tremendously challenging and where problems might take several days to complete – and the exam, which was an opportunity to show an understanding of the concepts [...].
- The special topics were very exciting and gave a lot of good perspective on how broad a topic topology really is.
- Assignments, some required others optional, encourage students to think beyond the simple requirements to succeed in the course, be it by researching an interesting topic or attending a seminar or writing a blog post.
- Her ability to effectively teach is helpful for students who may not be enthusiastic about the material at the onset, and her encouragement of extracurricular learning is incredibly helpful for those who are.

MATH 151a: Topology I, Fall 2015 (Brandeis University)

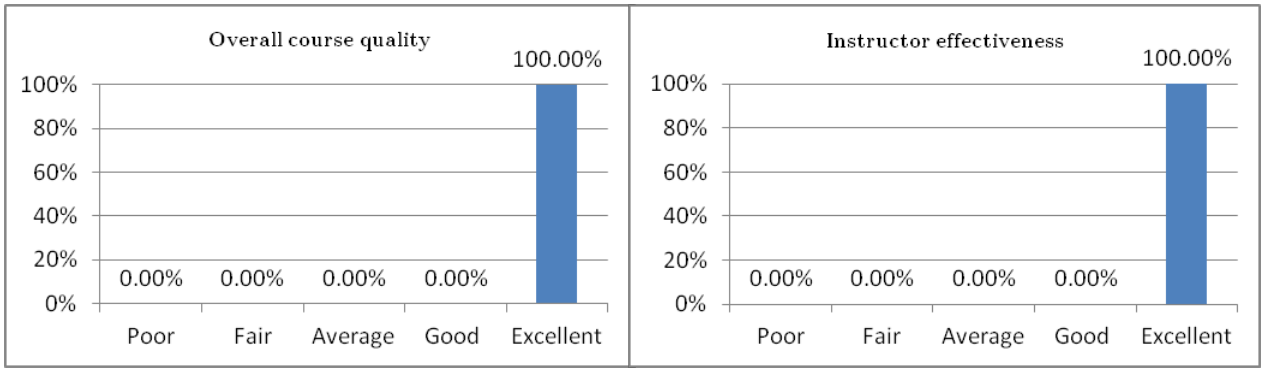


Responses: 9; Enrolled: 12.

Selected comments

- The professor is particularly good at illustrating both the "big picture" of this subject and yet also is very successful in presenting the important details in a satisfying and intuitive manner.
- Aru is excellent at telling a story in her lectures. She clearly states not only the content but also points out which parts are most important to focus on and motivate the material well.

MATH 100b: Introduction to algebra part II, Spring 2015 (Brandeis University)

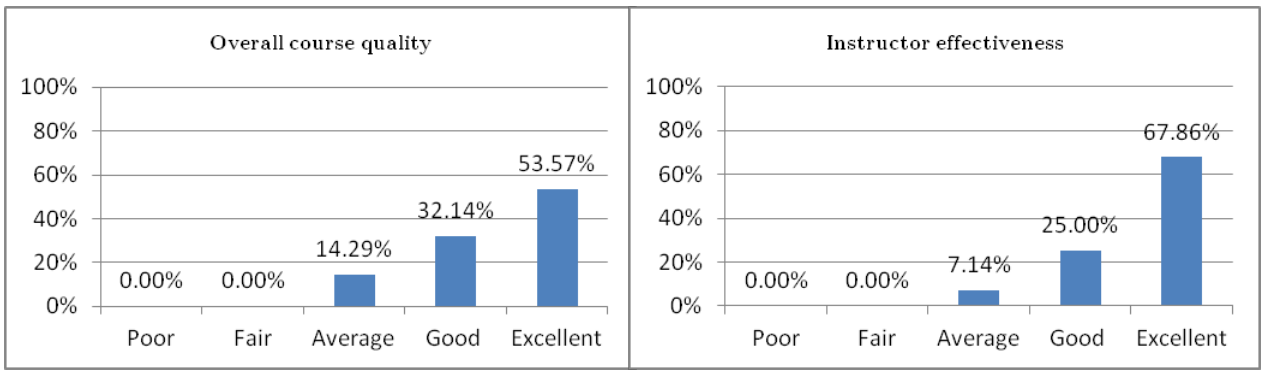


Responses: 6; Enrolled: 8.

Selected comments

- She [. . .] pushed her students to go above and beyond the typical standards of math classes by mandating self-directed study.
- I [. . .] enjoyed having a motivator for doing some self study at the end of the semester on a topic of interest to me.
- The unusual aspects of the class were very helpful for my learning and growing as an academic. For instance, I was able to practice my presenting and teaching ability in a comfortable environment and received helpful feedback on my abilities.
- It was good to practice giving lectures on math (as I hope to one day do so professionally) [. . .].
- I enjoyed the motivation to go to seminars and the chance to write about them.
- I [. . .] enjoyed the paper because it gives us liberty to apply or explore the algebraic nature of topics of interest.
- The research project at the end helped me explore an entire new area of math, as well as learn about new areas from other people. Thank you!

MATH 15a: Applied linear algebra, Spring 2015 (Brandeis University)

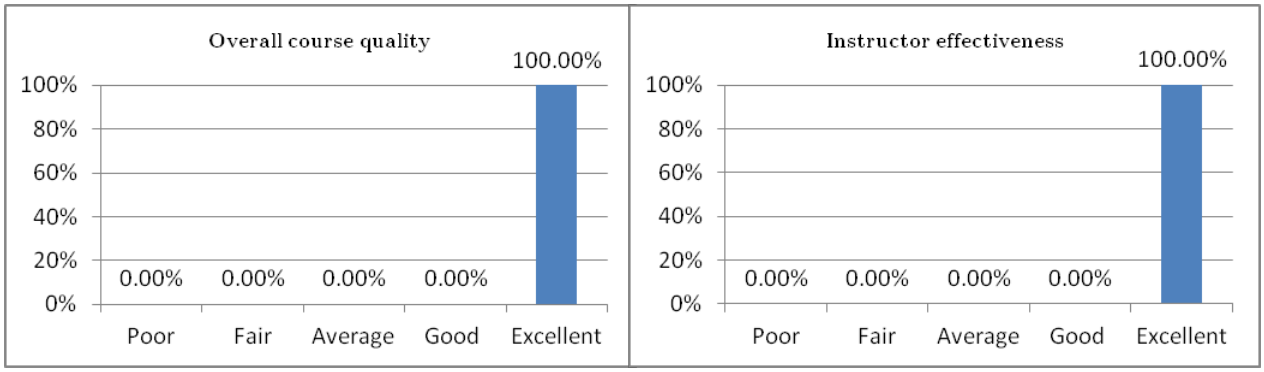


Responses: 28; Enrolled: 38.

Selected comments

- She also very patient when students have any questions for her. She respects every student's idea about the topic.
- She was consistently available for office hours and via e-mail, which made getting necessary help very easy and effective.
- I thought the course was very well-structured, and the professor was a very good teacher.
- She was clearly always organized and very knowledgeable about the subject matter.

MATH 151a: Topology I, Fall 2014 (Brandeis University)

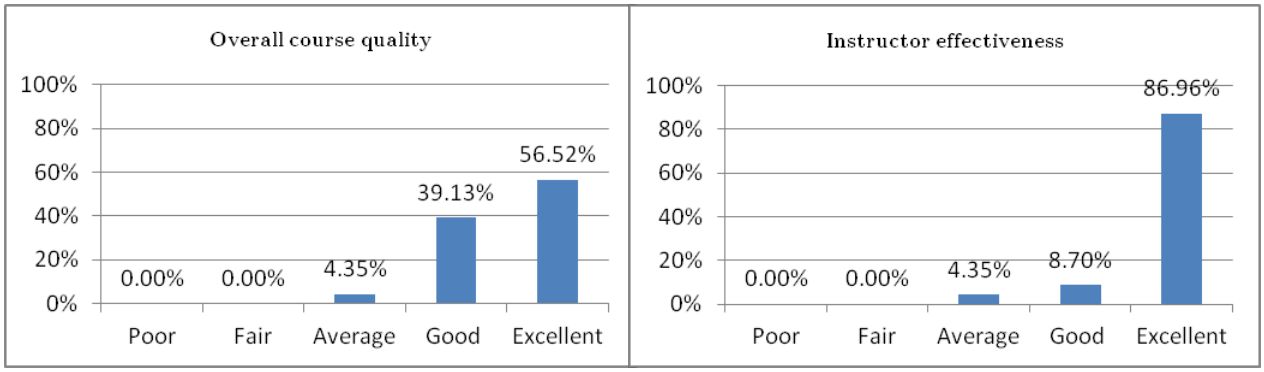


Responses: 3; Enrolled: 6.

Selected comments

- The lectures were [...] a good complement to the book, providing further explanation in sections that are difficult to follow, and glossing over details that are explained carefully in the text.
- The somewhat informal style of teaching helped to bring forward key ideas that would otherwise have been obscured by the convoluted proofs and complex formulations of their respective theorems.
- The exercises were well-chosen and required the student to understand the concepts at hand.

MATH 102: Calculus II, Fall 2011 (Rice University)



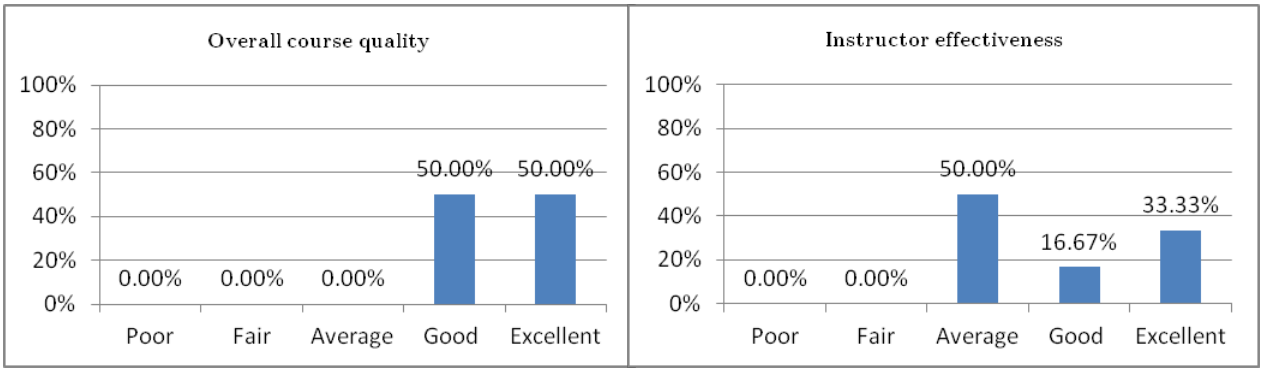
Responses: 23; Enrolled: 22[1].

Selected comments

- I [...] consistently felt in class that my views of math as a subject evolved. Every class period involved some further development of fundamental concepts (rather than monotonous practice, the new ideas were nicely blended with the practice).
- Aru is definitely the best teacher I have had at Rice. She explained the theories behind mathematical concepts and then went on to provide varied, useful examples. I wish other classes gave as many examples. For an engineering major, examples and applications of concepts are very important to me, and Aru definitely gave many of those.
- Aru was outstanding. I don't have any complaints whatsoever. When we had problems, she changed her style to accomodate the class. I'm sad I can't take another class with her =[
- Math is also not my favorite subject but she made it seem interesting to me. I do not have a single negative thing to say about Aru. She is one of the best professors I have had in my educational experience.
- Although this class has very difficult material, the Aru's ability to listen to our feedback throughout the semester made it very easy to handle and even enjoyable.
- Everyday, I would be shocked to see how the time had flown by. She is one of the most engaging instructors I have ever had.
- She clearly loves math, and this shows in the form of her math jokes and excitement when teaching. Her interest in it is infectious. Outstanding MATH 102 course with Aru.

[1]Rice freshmen are allowed to drop courses until the last day of the semester. I believe this is why the number of responses is greater than the number of students enrolled i.e. a student turned in evaluations and subsequently dropped the course.

MATH 102: Calculus II, Summer 2011 (Rice University)



Responses: 6; Enrolled: 7.

Selected comments

- Definitely do not change your approach to math and your enthusiasm. It really dictated the attitude of the class, which was a very fun atmosphere to learn in.
- I am very content with the class so far and I have truly started to enjoy doing math again, which is great!

For Rice University courses, responses to the prompts "Overall, I would rate the quality of the course as:" and "Effectiveness: Overall, I feel that the instructor's effectiveness as a teacher was:" have been displayed. Originally the students responded on the scale "1 (Outstanding), 2 (Good), 3 (Average), 2 (Fair), 1 (Poor)".

For Brandeis University courses, responses to the statements "The overall quality of this course was excellent" and "The instructor was effective as a lecturer and/or class leader" have been displayed. Originally the students responded on the scale "1 (Strongly disagree), 2 (Disagree), 3 (Neutral), 4 (Agree), 5 (Strongly Agree)".

Comments are reproduced as they were written including errors. Ellipses have been used to indicate when original comments were part of a longer sentence.

Complete teaching evaluations are available upon request.