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ABSTRACT

The purpose of this study was to talk with students about their experiences taking introductory statistics. There are few data in the current literature beyond "statistics anxiety" and test scores to tell us how students perceive the course. The researcher met with 11 students individually for 4 interviews throughout the semester, followed by a member-checking focus group during the last week of classes. One of the most salient themes to emerge from the data was the students' reliance on their instructor for feedback about performance, directions on taking notes, and creating a classroom environment that motivates them to study. Further, none of these students considered this course as different from any of their other courses except in content. The paper discusses some implications for helping instructors create supportive classroom environments through a model that stresses the interactions between students and instructors, both directly in the classroom and indirectly outside the classroom. (Author/SLD)

A Statistics Course with No Instructor? Why Students Would Revolt

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Paper presented at the Annual Meeting of the Mid-Western Educational Research Association, 15 – 18 October 2003, Columbus, Ohio.

Abstract

The purpose of this study was to talk to students about their experiences taking introductory statistics. There is very little data in the current literature beyond "statistics anxiety" and test scores to tell us how students perceive the course. I met with eleven students individually for four interviews throughout the semester, followed by a member-checking focus group during the last week of classes. One of the most salient themes to emerge from the data was the students' reliance on their instructor for feedback about performance, directions on taking notes, and creating a classroom environment that motivates them to study. Further, none of these students considered this course as different from any of their other courses except in content. I discuss some implications for helping instructors create supportive classroom environments through a model that stresses the interactions between students and instructors, both directly in the classroom and indirectly outside of the classroom.

Introduction

The current "statistics reform" paradigm stresses instructors teaching and students learning statistical concepts over mechanics. The goal of this model is to help students develop *relational* or *structural knowledge* in addition to declarative and mechanical knowledge (Earley, 2001). The most frequently cited implication is the need to develop assessment tools that are more concept-based and less calculation-based (Gal & Garfield, 1997). Carpenter and Lehrer (1999) discuss understanding in mathematics courses as a "mental activity" as well as something "emerging or developing rather than presuming that someone either does or does not understand a given topic, idea, or process" (p. 20). Garfield (1995) warns instructors that "no [teaching] method is perfect and will work with all students" (p. 32) and "teachers often overestimate how well their students understand basic concepts" (p. 31).

Thus, what we are not seeing in the literature are discussions of these "emerging" processes and understandings. What is also not heavily discussed in the literature is how students respond to more conceptually-based material. A look back at the statistics education literature reveals, in fact, that very few researchers have explored any of our students' *experiences* in statistics courses (there are some exceptions, most notably Oathout, 1995) – there is a more consistent focus on achievement outcomes (Becker, 1996). Of course, this does not include references to the well known "statistics anxiety" phenomenon. The shift away from mechanics and toward understanding is one attempt to decrease students' anxiety levels, under the assumption that reducing the mathematical content and rote memorization of definitions and formulae reduces students' worries about course performance.

What statistics educators and statistics education researchers have not explored in much depth is the total experience of taking a statistics course from the students' perspectives. What do students do to prepare for class? What do students do while in class?

What goes through students' minds during class? What aspects of class time help or hinder students' understandings of the material? What do students do when they leave class? The purpose of this phenomenological study was to begin this exploration with one very broad guiding question: "What is it like to take statistics from the student's point of view?" The purpose of this report is to outline results from preliminary analyses conducted during the course of the study.

Methods

Participants

My goal for recruiting participants was to get a mix of students from across campus. Eligible students included those over the age of 18 and enrolled in an introductory statistics course during the spring 2003 term. In January 2003, I posted flyers next to the doors of all 21 classrooms in which one or more of the 40 introductory statistics courses were held. The flyer asked students to contact me via phone or e-mail, and I set up times to meet with the first twelve who did so. I offered a $120 incentive to students who completed the study.

Table 1 lists relevant demographic information for the eleven students I interviewed (one student dropped out of the study after the first interview). I did achieve the variety I initially wanted: my group included participants from freshman to senior with one graduate student, a GPA range of 2.00 – 4.00, and students from four of the six departments offering statistics courses (no students from the Sociology or Criminal Justice courses contacted me).

Table 1. Demographic Summary

Participant [a]	Gender	Course Taken	GPA	Class
Aileen	Female	Psychology 270	3.60	Senior
Alastair	Male	Statistics 211	2.60	Sophomore
Brice	Male	Psychology 270	4.00	Senior
Brigit	Female	Math 115	3.77	Sophomore
Cecily	Female	EDFI 641	4.00	1st Year Graduate
Cedric	Male	Statistics 211	2.92	Freshman
Dillan	Male	Math 115	2.90	Sophomore
Eleyn	Female	Math 115	4.00	Freshman
Evan	Male	Statistics 211	2.50	Sophomore
Griffin	Male	Math 115	2.00	Freshman
Ian	Male	Statistics 211	3.66	Sophomore

[a] All names used in this report are pseudonyms.

Data Collection

I met with each student for one-on-one interviews in my office four times (the only exception was Ian, who started the study late and only met with me three times). We spaced interviews approximately 3 to 4 weeks apart depending on the student's schedule. I had an initial list of questions I wanted to discuss, based in part on my interests and in part on themes emerging from the previous interviews. Each interview began, however, with the

general question, "So how is class going for you?" From there, we discussed whatever the student brought up as important at that time. Interview times ranged from 15 to 45 minutes, entirely dependent on how much the student had to say. I audio taped the interviews and took fieldnotes during our discussion. I then transcribed audiotapes, taking additional fieldnotes as I listened to our discussion again.

During the last week of classes, I met with nine of my participants in two member-checking focus groups (two students in the first, seven in the second). I wanted to present students with a summary of the major themes I had heard during our discussions and get group feedback on whether these were actually important to the students. We also discussed some of them in more detail, so I was able to collect additional data as well.

Results

Even with the variety of students I talked to, as well as the diversity of their classroom environments, three common themes emerged across all of our discussions: (a) *student behaviors and characteristics,* (b) *instructor behaviors and characteristics,* and (c) *resources used for study.* This report focuses on the second of these: the students' perceptions of the instructor and his or her behaviors. During the first two sets of discussions, this idea came across in a variety of my participants' responses to questions, regardless of whether I had directly asked about the instructor. Based on this preliminary analysis, I asked students the following question during our third discussion:

> *Imagine you had to take this course entirely online. There is no identified instructor now – you read texts and examples online, complete assignments and tests online, and receive scores via e-mail. What would that be like?*

My intent here was to focus on what students would miss about their instructors, having discussed them so much during our first two interviews.

Responses to this question, along with questions from earlier discussions, fell into three major sub-themes:

(1) The instructor's use of class time (including pace and teaching style),

(2) The instructor's role in the note-taking process, and

(3) The instructor's assessment strategies (including homework and exams).

I present next a set of some quotes that led me to each theme as well as summaries of each of these themes.

The Instructor's Use of Class Time

One of my early interests in conducting this study was to find out what it is like to just be in a statistics class: what are students thinking, and what kinds of behaviors do they exhibit, and most importantly, *why*? For most students, the response to what they do in class was "sit there and take notes." What thoughts did they have during class? For some, they were random because, as Brigit said,

> *It's hard to stay focused on it because all she does is write definitions from the book onto the board and then just reads them and explains them a little bit. Very rarely we go through examples of things, but mostly it's just definitions.*

For Brigit and others, instructors organized class time around the traditional "lecture" approach with very little interaction among students. There were exceptions, in particular Griffin's instructor, who did no formal instruction but rather assigned group work from the text and was "there to answer questions. If we didn't have any, we finished our exercises and left." This led Griffin to describe his instructor as "unmotivated" and "not interested at all," which then made Griffin feel as though there was no reason to do the work for the course – "why should I care about the class if he doesn't?"

When asked about the online course, only Griffin was excited at the prospect of "taking the class while I stay in bed." The remaining ten participants each expressed concern

that this type of setting, most notably the absence of an instructor, would never work for statistics. Cecily was most vocal (her eyes nearly popped out of her head when I asked her that question) in wanting to avoid this type of course:

> *Wow … no way of asking questions? There's gotta be a way of asking questions … I have a math background, I'm pretty good at math. But this is not just a math class … there's a lot of concepts here that just reading the book [won't work] … yeah I may be able to pass the class but I wouldn't know it. I wouldn't be able to use it.*

Cedric commented that the book tells *what* not *why* – being in class with both peers and an instructor to "shed different light on it" is necessary. Of course, he also struggled with a pace he considered to be too fast because the instructor completes a few examples and moves on: "there isn't much discussion on how things work … it's more just 'this works' and this is how you reason it out." Overall, students who had instructors giving *and explaining* examples in class were more comfortable with their experience – students who were not getting these examples commented they wish their instructors would do more of "the whys" instead of just "the whats".

The Instructor's Role in the Note-Taking Process

A natural progression from the first sub-theme on instructor behaviors and characteristics is how these behaviors influence students' note-taking processes. Students consistently reported relying predominately on their notes for studying course material. This is also how they each spent their time in class (again with the exception of Griffin noted above) – listening to the instructor and writing down whatever he or she writes on the blackboard or overhead. I asked students how they decided what to write down, and most indicated it was "whatever the instructor writes down." Brice and Cedric both mentioned they will also jot down notes to themselves about key formulae or concepts to remember.

Evan, Ian, and Alastair each had instructors who provided handouts with full or partial notes already on them. For these students, this meant they just followed along and

maybe filled in an example or two – Evan called this "being spoon fed" the information. With or without these handouts, students rely very heavily on their notes for studying. Cedric further indicated that he has experienced the "false safety net" of feeling as though he is following along in class, not taking any notes as a result, and then being lost when he got home to study for the test (having no notes to refer to). Here again, students all mentioned either being happy with an instructor who walked through examples in class (so these could go into their notes) or being unhappy with an instructor who did not do so.

Three of my participants had sold their books back by the first interview (within a month of class starting), another two sold them back later in the term, and five of the remaining six students used their books for assigned homework problems only. Only Cecily read the textbook in between classes, though she indicated it was difficult to do. Brigit and Dillan struggled with this the most because their instructor "lectured" directly from the book:

> *This class is different because instead of having the professor's point of view on the notes, it's just point blank – I look at my book and I looked at my notes and it's word for word* (Brigit).

Dillan indicated it was almost "stupid" to go to class because he can sit at home and read the book – what he and other students want from instructors is explanations and "different viewpoints," not dictation. The textbook was not enough, but the instructor in this case was not serving as an extra resource and this bothered them.

The Instructor's Assessment Strategies

There was an overwhelming consensus from all of my participants that regular homework and frequent assessment are necessary in order for students to know whether or not they are learning anything. As Brice put it:

> *Each person in the class was left on their own to make sense of what was being presented … maybe it felt like a struggle because if we'd had some more problems … we'd have some confirmation of*

> *whether or not we understood the material. Maybe it was a struggle because we just didn't know for sure if we understood it or not – we just really didn't have any confirmation of that.*

Brice and others were concerned that with no practice, no regular homework, and no assignments to work on, preparing for exams was more difficult and led to an increase in anxiety prior to exams. Cecily mentioned that "a computer can give you the answer, but it doesn't give you how it got the answer," and so for her the additional need was for the instructor to *go over* the assessments when returning them to students.

Students also spoke frequently of disappointing quizzes and tests, referencing "what the instructor told us would be on the test" as their study guide. Although I did not look at individual assessments unless the student asked me a question about them, my participants' experiences were clearly impacted by what they perceived to be poor test development. A major piece of this was being tested on "applications" when students were not given models in class. Even though many students called for and recognized the need to understand what it is they were doing, they wanted instructors to guide them in this process. Cedric's first exam experience was particularly enlightening:

> *Right answer, wrong work, so a lot of points were taken off. The one thing is, she doesn't accept just the answer. Even if you do some work, unless you do the right work it will be marked wrong. I can understand that if we're majors, but we're general business majors. Just getting the right answer is enough. Recognizing wrong answers is good, but not exactly knowing step-by-step.*

This conflict between Cedric's realization that understanding is important (from earlier conversations) but not being comfortable when tested on this understanding, is important to me. It highlights the need for instructors to more closely match their instruction and assessment procedures so students do not get these conflicting messages.

Discussion

Obviously all of these sub-themes are intimately related to each other, as well as to the two other larger themes of student characteristics and behaviors and use of resources. It

is intuitive that the instructor plays a key role in students' class experiences, but for me the surprising aspect of all of our conversations was the *extent* to which students relied on their instructors. What we do in the classroom has far-reaching impacts beyond how students feel during class. When on their own, students need resources that will help them make sense of class material. Those participants most comfortable with their experiences indicated they could take their notes home, complete homework assignments by referring to their notes as necessary, and received consistent feedback from their instructor as to whether they were indeed "getting it." Oathout's (1995) participants echoed "strongly favor[ing] frequent tests" (p. 50) and a lack of "mapping from lectures and assignments to test content and format [is] equally problematic" (p. 48).

Many students, however, did not do much work outside of class because graded assignments were either non-existent or infrequent. This meant their statistics course was "the lowest priority class" and they rarely did anything with the material outside of class time. There was an even stronger need for notes to be clear and complete, and for these notes (typically verbatim from instructor notes in class) to be reflective of what would be assessed on the exams. The exams became the focal point for these students – they took notes so they would have something to study so they could do well on the exams. As Garfield (1995) states, "students learn to value what they know will be assessed" (p. 32). They usually waited until an exam was coming up to actually go back over their notes, so questions could not be addressed and they were sometimes still confused and unsure going into the exam. How the instructor conducted class, what the students felt was noteworthy, how the instructor assessed students in between exams, and how the instructor developed exams all become a single system to which instructors need to pay close attention.

Conclusion

Although it appears intuitive that students rely on their instructors in any course, there are some implications that may not be as intuitive. Based on my own observations as an instructor, as well as comments provided by the students in this study, a primary motivation for students in introductory statistics to do anything (take notes, work problems, study outside of class, etc.) is how it will impact their final grade. Students further mentioned that they appreciate graded assignments as a way to make sure they know what the instructor wants them to know. Here we see a direct connection between how we assess students, the opportunities we provide for assessment, and *why* we assess them at all.

Assessment systems in any course gauge whether or not the students are meeting course objectives. As we work to develop introductory statistics courses oriented more toward understanding and less toward mechanics, our assessment systems must change as well. As we change our assessments, so too must our classroom environment change to encourage students' development of understanding over their mastery of mechanics (Treagust, Jacobowitz, Gallagher, & Parker, 2001). Demetrulias (1988) argues that an "opportunity to understand statistics from an integrated and flexible viewpoint must go along with a classroom environment that rewards such exploration" (p. 169). As students in this study report, what happens in class becomes their main resource for any work they do outside of class. Spending time on "how to understand" as much as "what to understand" becomes critical, and instructors must continue to develop and make use of delivery techniques, classroom examples, and homework activities that focus on this "how to" piece.

Questions for Instructors and Statistics Education Researchers

As I reflected on the discussions I engaged in with these students, my thoughts turned to my own teaching philosophy and classroom environment. Questions that

developed as a result of these interactions, questions I believe worthy of further exploration and discussion, include:

(1) What are my expectations of students during and outside of class meetings?

(2) What role does the textbook play in my course?

(3) How can I best assist students in taking complete and accurate notes?

(4) What is the connection between each class activity and/or discussion and assessment of student understandings?

I firmly believe as instructors we need to spend more time reflecting on our own teaching philosophies and practices, and for me, this reflection requires student feedback. Statistics education researchers should also consider these questions, and begin to focus research more on these "emerging understandings" so we can continue to learn how students are responding to our desire for them to walk away from the course with some knowledge of what and why various concepts were covered, rather than walking away with the feeling that all they did was "plug and chug."

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