

What Uncouples Students' Goals from Students' Outcomes in Introductory Biology Courses?

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Abstract

On the first day of classes, most students in introductory biology courses (a) believe that their effort is the most accurate predictor of their academic success, and (b) are confident that they will work hard and earn high grades. Despite their optimism, many students do not follow through on their expectations, and their grades drop accordingly. When asked about their academic behaviors, many students provide misleading answers. A lack of academic motivation is what often uncouples most students' academic goals from their academic outcomes in introductory biology. These results are discussed relative to how biology teachers can help students succeed in introductory biology courses.

High school and college students know that a college education is important for attaining financial security and earning societal respect (Feller, 2005; Viadero, 2005). To obtain the benefits and choices afforded by a college education, more students than ever are enrolling in college. Although today's high school graduates have the highest grades on record, many students who enter college are not prepared for the academic challenges that await them (Sax, Lindholm, Astin, Korn, & Mahoney, 2002; Young, 2002). College freshmen are especially under-prepared for biology courses. For example, only one-in-four high school graduates who took the ACT (a popular standardized-test that many colleges and universities in North America use for admissions decisions) in 2004 were academically prepared to take college biology (Cavanagh, 2004). This helps to explain why up to half of students at many colleges and universities earn a D, F, or W in introductory science courses (Congos, Langsam, & Schoeps, 1997).

Students' problems in biology courses are expressed in many ways, including the following conversation in which virtually all biology teachers have participated:

Teacher: Thanks for coming by my office. How can I help you?

Student: I need to talk with you about my grade on the last exam. I didn't do as well as I should have.

Teacher: What was the problem?

Student: I don't know. I should have done better, because I did everything that you told us to do.

Teacher: You came to class every day and paid attention?

Student: Yes.

Teacher: You did all of the assignments?

Student: Yes.

Teacher: You read and studied the assigned pages in the textbook?

Student: Yes--every page.

Teacher: You attended the review session?

Student: Yes.

Teacher: Really? You did all those things? What did you get on the exam?

Student: I failed.

Teacher: Hmm...

These conversations frustrate us because we assume that students want to do well in our courses, and that they're honest with us when they visit us outside of class. Although we know that doing the things that we suggest won't always produce A's, we also know that following our suggestions shouldn't produce F's. What's the problem here? What uncouples students' goals from their academic performances in introductory biology courses?

I tried to answer this question by studying how the goals and expectations of first-year students in introductory biology courses are associated with students' academic behaviors and academic performances. I did this by comparing students' grades and academic expectations with easily measured behaviors that represent students' academic motivation--namely, attendance at class, compliance with reading assignments, attendance at help-sessions, and participation in course-related activities.

Methods

This study was conducted for 3 years (2002 through 2004) in several large sections of a four-credit introductory "mixed majors" biology course at the University of Minnesota. All sections of the course met near the same time of day and were taught by the same instructor in the same classroom in the same way (e.g., the same syllabus, textbook, sequence of topics, grading policy, exams, and pedagogical techniques such as the same multimedia presentations, guest speakers, group discussions, and in-class writing assignments). The course syllabus included the following statement about the importance of class attendance and academic engagement for academic success: "I expect you to prepare for and attend every class. This is important because class attendance is usually a strong indicator of course performance." I also discussed this statement, and the importance of attendance and course engagement, on the first day of class. The biology course in this study, which was a traditional biology course taught in a traditional way (e.g., lectures and labs), is described in more detail elsewhere (Moore, 2003a, 2003b).

Each aspect of this study included at least 487 students. These students were ethnically diverse: 51% White, 21% Black, 5% Hispanic, 20% Asian/Pacific Islander, and 3% other or missing information. These students had an average high school graduation percentile ranking of 54 and an average composite ACT score of 20. Approximately one half of the students were females, and virtually all of the students (98%) had taken a biology course in high school.

Academic behaviors. I measured the following academic behaviors:

1. *Attendance at lectures.* I recorded attendance at every class.
2. *Attendance at help sessions.* Help sessions were held before each of the four exams in the course and were conducted by teaching assistants who had no knowledge of, or input regarding, any of the exams. On exams, students were asked to identify whether they had attended the help session for that exam. Attendance was recorded at each help-session, and students were considered attendees if they attended at least one help-session. Attendance at the help sessions was optional, and students who attended the help sessions received no points or "inside information" about upcoming exams. The academic behaviors and performances of students who attended at least one help-session were compared with those who attended no help-sessions.
3. *Submission of extra-credit work.* Exams in the course were numbered, distributed individually to students, and collected from every student after the exams; no students had access to old exams. Students could earn one third of the points that they had missed on each lecture exam if they wrote a one-page essay about each of the questions that they missed on the exam. Students had 6 weeks to write and submit these essays, and the extra-credit points were

guaranteed for any reasonable effort. Points earned by students who submitted extra-credit work were excluded from all calculations of grades in this study.

4. *Compliance with reading assignments.* The course syllabus stated prominently that “reading assignments are strict requirements for this course.” During the first week of class, the beneficial and compulsory nature of reading assignments was emphasized repeatedly to students. I also emphasized on the first day of classes that, as was noted in bold print in the syllabus, the first assignment was “to read the entire syllabus before the beginning of the next class.”

The syllabus included a separate section titled “Your First Assignment” that was printed in a bold font and that read as follows: “Your final grade will be raised by 1% if you e-mail the word ‘bonus’ to [the instructor] before the start of the second class.” This offer was valid only once (i.e., before the start of the second class). All students had access to e-mail, but could have also obtained the reward by calling me, coming to my office, seeing me outside of class, or leaving a message that indicated that they had read the entire syllabus before the second class. I did not distribute syllabi until the end of the first class to prevent variance among students reading them during class.

On the second day of classes, I administered another survey that asked the following question: “Your first assignment was to read the entire syllabus. Did you read the entire syllabus?” All students who had read the entire syllabus would presumably have been eager to earn a bonus point for doing so. Students who missed the first class were not included in the survey. These surveys, which had been approved by the Institutional Review Board of the University of Minnesota, were not examined or tabulated until after final course grades had been submitted.

Students’ expectations in introductory biology classes. On the first day of classes, I gave students a survey that asked the following questions: (a) What grade do you expect to earn in this course? (b) What percentage of classes will you attend? (c) Will you do extra-credit work if given an opportunity to do so? (d) Will you come to help-sessions before exams? (e) Do you believe that you will earn a higher grade in this course if you attend class regularly? (f) Will you respond honestly to questions about class attendance and compliance with reading assignments? (g) Which of the following is most responsible for your grades: your own ability, your own effort, the ease or difficulty of the course, or good or bad luck? Students were told throughout the semester to keep a record of their class attendance, and on the last day of class were told to know their rate of class attendance for the final exam. At the final exam, I asked students to list (a) the percentage of classes that they had attended, and (b) whether they had attended a help-session during the semester. These surveys, which had been approved by the Institutional Review Board of the University of Minnesota, were not examined or tabulated until after final course grades had been submitted.

Results

On the first day of classes, virtually all (i.e., 96%) of students believed that they would make a higher grade in the course if they attended class regularly. Students’ responses to the question “Which of the following is most responsible for your grades?” were as follows: my own ability, 12%; my own effort, 83%; the ease or difficulty of the course, 4%; good or bad luck, 1%.

On the first day of class, 55% of students predicted that they would earn an A, 40% predicted that they would earn a B, 4% predicted they would earn a C, and no students predicted that they would earn a D or F. The final grade distribution in the course was as follows: A = 9%, B = 26%, C = 30%, D = 15%, and F = 20%.

On the first day of class, 95% of students claimed that they would respond honestly to questions about class attendance and compliance with reading assignments. Although 74% of these students claimed on the second day of classes that they had read the entire syllabus (as instructed), only 1% of the students had submitted the “bonus” e-mail or message. During subsequent years, the percentage of responses rose steadily to 32% as “word got out” about the assignment.

Table 1 describes the claims made by students about their academic behaviors (i.e., attending class, doing extra-credit work, and attending help-sessions) and performances on the first day and last day of classes, as well as their actual behaviors and performances. Most students fell far short of their predicted behaviors and grades. Many students also lied about their academic behaviors (e.g., 41% claimed that they had attended a help session, but only 25% had actually attended one).

Table 1

Students’ Predictions and Claims About Their Academic Behaviors and Grades During the First and Last Weeks of Class, as Compared With Their Actual Behaviors and Outcomes. Numbers in the Table are Means (N ≥ 487)

Aspect	Predicted first week of classes	Claimed last week of classes	Actual
I will attend/attended a help-session.	81%	41%	25%
I will attend/attended approximately ____% of classes.	89	85	69
I will do an extra-credit assignment if given an opportunity to do so.	82%		24%
My course grade will be ____%.	92		70

Discussion

Students believe that their effort is the most important determinant of their grade in introductory biology courses. On the first day of classes, more than 80% of first-year biology students believe that their academic success will be due primarily to their effort, and not due to their ability, the ease or difficulty of the course, or luck. Students also believe that attending class, doing extra-credit work, and attending help-sessions will help them make higher grades. This is consistent with the fact that students who predict they will earn an A also predict that they will come to class more often than students who predict that they will earn a C (Moore, 2003a, 2003b). These results indicate that most first-year students understand the importance of course-related work, and know which behaviors are important for success. Indeed, most students’ success in introductory biology is strongly associated with motivation-based behaviors (Moore, 2004b; Thomas & Higbee, 2000).

Not surprisingly, most first-year students are confident on the first day of class that they will work hard enough to earn high grades. For example, they predict that they will attend an average of 89% of classes; large majorities also predict that they will attend help-sessions and do extra-credit work if given an opportunity to do so. In light of this confidence about their predicted level of effort, it is not surprising that more than 90% of biology students believe they will earn an A or B in the course (Moore, 2003a, 2003b), despite the fact that many students have had negative experiences in earlier science courses (Congos, Langsam, & Schoeps, 1997). Taken together,

these results indicate that most introductory biology students are optimistic on the first day of classes about their commitment toward, and the probable outcome of, their upcoming academic experience in introductory biology courses.

Students who follow through on their predicted behaviors usually do well (Launius, 1997; Moore, 2003a, 2003b, 2004a, 2004b; Thomas & Higbee, 2000; Wiley, 1992). This success occurs despite students' admission scores and academic histories (Moore, 2003a, 2003b). This is why the most successful students are usually the most highly motivated; they are the most likely to come to class, do extra-credit work, and attend help-sessions. The importance of effort and motivation for academic success was summarized this way by Thompson (2002): "If a student ever complains about a grade or how tough the course is, one of the first things I look at is class attendance. That usually says it all" (p. B5). Thomas and Higbee (2000) were more succinct when they concluded that "nothing replaces being present in class" (p. 229). The results of this and other studies (Launius, 1997; Moore, 2003a, 2003b; Romer, 1993) support this conclusion. Hard work can help students overcome obstacles and become successful.

However, students' confidence about their future efforts is often unjustified. Many students fall far short of their predicted effort and grades; they do not come to class as much, attend help-sessions as much, or do extra-credit work as much as they predicted they would on the first day of class (Table 1). These results are consistent with previous reports (Friedman, Rodriguez, & McComb, 2001; Romer, 1993) and indicate that many students (a) do not follow through on their academic intentions, and (b) have behaviors that are inconsistent with academic success (Pintrich & Garcia, 1994; VanZile-Tamsen & Livingston, 1999; Yaworski, Weber, & Ibrahim, 2000). That is, many students know that attending class, doing extra-credit work, and attending help-sessions will probably improve their grade, yet they choose to ignore these opportunities anyway. Although many students' efforts (e.g., class attendance) diminish as the semester progresses, the lack of effort reported here regarding reading the course syllabus occurred during the first week of class when students' optimism and expectations were high. These results are similar to those reported for students in other courses (e.g., Sappington, Kinsey, & Munsayac, 2002) and indicate that (a) large percentages of college students seldom or never read assignments or do other course-related activities by the due dates, even when encouraged to do so by their instructors (Connor-Greene, 2000; Gris  & Kenney, 2003), and (b) many students have motivation-related behaviors that impede academic success (Yaworski, Weber, & Ibrahim, 2000). The apathy and detrimental academic behaviors that typify unsuccessful students often begin in high school (Gehring, 2003; Peterson & Colangelo, 1996). Since these poor academic behaviors have been rewarded with the highest grades on record (Young & Sowa, 2002), it's not surprising that many first-year students believe that they are prepared for college, that college is merely the 13th grade, and that the same amount of effort that produced their high grades in high school will produce the same grades in college (Toppo, 2005; Young, 2002). When it does not, many students do not change their academic behaviors; they continue to miss classes and ignore course-related opportunities and, as a result, often continue to fail. This is why most students who earn failing grades during their first semester continue the same behaviors and, not surprisingly, make similar grades during their second semester (Moore, 2004a). Instructors should use quantitative data such as those shown in Table 1 and elsewhere (Moore, 2003a, 2003b, 2004a) to convince students of the probable outcomes of their academic behaviors. Commitment is essential; without it, students' other traits (e.g., aptitude) don't matter.

Although input from students can be useful for improving academic programs and procedures, students' claims about their academic behaviors are often misleading. Although more than 90% of the students in this study indicated that they would respond honestly to questions about class

attendance and compliance with reading assignments, many more students claimed that they came to class, did assigned work, and attended help-sessions than actually did come to class, did assigned work, and attend help-sessions. Similarly, only about 1% of students who claimed to have read the entire syllabus obtained the reward that would have been uncovered if they had, in fact, read the entire syllabus. Although some students may not have cared about the reward, a more likely explanation is that students did read the entire syllabus. These misrepresentations have important consequences, for they greatly complicate instructors' and advisors' efforts to help students succeed. When we try to identify and remedy behaviors that impede success, many students will mislead us with answers that are not true. Our responses to these misrepresentations often address a lack of skills (e.g., sending students for tests of reading comprehension, routing students to remedial courses) rather than a lack of motivation. As a result, our interventions often unnecessarily divert resources when, in fact, the underlying problem may be that the students simply haven't tried very hard (e.g., they haven't come to class, haven't attended help-sessions, and haven't participated in course-related opportunities). Instructors should be skeptical of students' self-serving responses when designing strategies and interventions for improving students' academic performance.

Conclusion

The associations noted here are not perfect, and what I report does not explain all academic behaviors and outcomes. Indeed, such associations are not necessarily with cause. Although academic success is influenced by many factors beyond motivation (e.g., the alignment of academic behaviors, abilities, course content, and assessment), the primary determinant of many students' academic success is academic motivation, which is expressed in behaviors such as class attendance and course engagement. This is why many students who drop out of college list a lack of motivation as the top reason for their failure (Hatfield, 2003). In introductory biology courses, it is usually a lack of academic motivation that uncouples many students' academic goals from their academic outcomes.

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