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Observations of Student Behavior in Collaborative Learning Groups

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Abstract

In an effort to determine how our students were responding to the use of collaborative learning groups in our large enrollment introductory astronomy (ASTRO 101) courses, we systematically observed the behavior of 270 undergraduate students working in 48 self-formed groups. Their observed behaviors were classified as: (i) actively engaged; (ii) watching actively; (iii) watching passively; and (iv) disengaged. We found that male behavior is consistent regardless of the sex-composition of the groups. However, females were categorized as watching passively and or disengaged significantly more frequently when working in groups that contained uneven numbers of males and females. This *case study* observation suggests that faculty who use collaborative learning groups might find that the level of student participation in collaborative group learning activities can depend on the sex- composition of the group.

1. INTRODUCTION

A dominant theme in collegiate-level science education reform in the last decade has been the desire to move students from passive observers in the traditional large lecture to fully engaged participants. This has been motivated, at least in part, by various educational research studies that repeatedly demonstrate that a student's ability to learn effectively from lectures is significantly degraded after only 15-18 minutes

(Centra 1993). Collectively, these studies suggest that the majority of the time devoted to lectures is largely wasted. More recently, a movement toward active learning is being fueled by a series of studies demonstrating that students enrolled in a variety of lecture-intensive courses perform poorly on a variety of measures as compared to students in interactive-engagement courses (e.g., Hake 1998). Moreover, many of our best students appear to be leaving science and engineering majors simply due to boredom and what they perceive as courses that are unchallenging and full of memorization (Seymour 1992; 1995). Particularly vulnerable to the ineffectiveness of traditional instruction are female students, who are already underrepresented in science career fields (Kahle & Meece 1994).

Among a long list of promising active learning strategies available to faculty to better engage students is an approach generally known as collaborative (or cooperative) small group learning. In its most rudimentary form, collaborative learning groups of three or four students are assigned a challenging task or an open-ended problem to solve together. The overarching goal of the collaborative learning approach is to encourage active student participation in the learning process by creating an environment "that involves students in doing things and thinking about the things they are doing" (Bonwell & Eison 1991). The effectiveness of this approach has been extensively studied and the strategy has been implemented in a variety of settings, the details of which have been documented elsewhere (Adams & Slater 2001; Beaudrie, Slater, Stevenson, & Caditz 1998; Heller & Hollabaugh 1992; Slavin 1991; among many others).

Several years ago, we began using collaborative learning groups in our large enrollment (initially 180 students per section, but now rapidly growing) introductory astronomy lecture course at Montana State University. The course meets three times per week for fifty minutes in a state-of-the-art lecture auditorium ideally suited to didactic-lecture instruction. Our approach was to create weekly student activities in which students are asked to complete one of several conceptual, historical, science-process, or open-ended activities (Adams & Slater 2000; 1998). Each activity is designed to be completed in a lecture auditorium, with almost no equipment, in 20 to 40 minutes, depending on the particular activity. The group activities count 25% toward the student's final course grade.

At the beginning of each semester, students are asked to self-form groups of four. They are told that they will be working in their groups on a weekly basis, as well as during some exams. Although many groups are stable, a substantial portion changes members frequently as class attendance waxes and wanes; this is common in many large-lecture science courses for non-science majors. Students are also instructed to rotate within groups among defined roles: leader, recorder, skeptic, and explorer. Activities are typically performed during the last portion of the class period, with no forewarning about which days the activities are scheduled in order to encourage attendance. All work is to be completed during the regular class session; no make-up activities are allowed to further encourage student attendance.

As we were becoming interested in a number of gender-related issues being reported in the literature about varying success in introductory science courses (e.g., Brown, Slater, & Adams 1998; Didion 1993, 1994, 1996), we decided we should undertake systematic observations of our students to determine if males and females were participating equally in collaborative learning group activities. This paper describes the results of our study undertaken to characterize students' behaviors while working in collaborative learning groups.

2. METHOD

The participants in this study were the approximately 270 students in the introductory astronomy course who attended class during the four class sessions over which student behaviors were systematically observed. The population was 58% male and 42% female and predominantly Caucasian, and most students were majoring in non-science degree programs. To determine the sex-composition of self-formed groups, we asked students to record on student-submitted activity sheets the number of males and females in their group.

In an effort to systematically observe student behavior, four female astronomy educators came to campus to observe four class meetings. Prior to making the observations, the authors agreed upon a common observational protocol for documenting the behavior of students within groups. Four general behaviors were characterized and defined as: (i) actively engaged; (ii) watching actively; (iii) watching passively; and (iv) disengaged. *Actively engaged* meant the student was talking to one or more group members or writing on the student-activity sheet (in this setting, it was not possible to determine whether or not the individual was actually discussing the class activity). *Watching actively* meant that the student was nodding her or his head or otherwise indicating that she or he was listening by leaning forward and making eye contact with the speaker or by intently studying her or his book or activity sheet. *Watching passively* meant that the student was sitting back, not necessarily making eye contact with the speaker, but looking toward the group or toward the student activity sheet. *Disengaged* meant that the student was looking away from his or her group or speaker, reading extraneous material (such as a newspaper), talking to a student not in her or his group, or clearly distracted. The postures of disengaged students were much more relaxed than those who were watching passively or watching actively.

At the beginning of each class, the four observers distributed themselves around the lecture hall and selected three nearby groups to monitor. Over the course of four class sessions, 48 different groups were observed. The observers noted the behavior of each student in each group on a recording sheet every two minutes to create a time-series of student behaviors.

3. RESULTS

Table 1 shows the gender distribution of self-formed groups for a one-class meeting in this study. The one striking feature of the distribution is the large number of all-male groups, as compared to the number of all-female groups. Although there were slightly more men than women in the class, the weighted-average shows that only 27% of women were in all-female groups, whereas 44% of men were in all-male groups. Twenty-two percent of the class worked in groups with equal numbers of males and females. The remaining were mixed-sex groups of three males and one female or three females and one male. There is a clear inclination here for males to form single-sex groups that does not seem to occur with female students. We can only conceive of two possibilities: that some male students barge into mostly female groups or that predominantly female groups seek out a male student to join their group. Informal interviews have provided no insight into this phenomenon, and we are at a loss for how to explore this further. For whatever the reason, these students did not evenly distribute themselves by sex. These distributions are consistent with our students' behaviors semester to semester and continue in our courses today.

Table 1. Composition of Self-Formed Small Learning Groups by Sex

Women	Men	# Groups	F	M
4	0	3	12	0
3	0	4	12	0
2	0	3	6	0
3	1	6	18	6
2	1	9	18	9
2	2	13	26	26
1	1	4	4	4
1	2	8	8	16
1	3	9	9	27
0	2	4	0	8
0	3	7	0	21
0	4	10	0	40

NOTE: In this observation, 30 of 113 women are in single-sex groups, whereas 69 of 157 men are in single- sex groups.

Students forming an uneven distribution of students is not necessarily bad in and of itself. However, the uneven distribution of sex among groups in the class becomes disconcerting when individual student behaviors are disaggregated by sex for different group compositions. Major behavior differences between single-sex groups and mixed-sex groups become apparent. As shown in Table 2, systematic observations reveal that 35% of males were disengaged or watching passively about one-quarter of the time, independent of the sex-composition of their groups. Female students, on the other hand, exhibited very different behaviors depending on the sex-composition of their group. Fourteen percent of females were disengaged or watching passively one-quarter of the time when in all-female groups, and 17% when working in groups with equal numbers of males and females. However, when females were in mixed groups of unequal numbers of females and males, nearly 38% of females spent a quarter of the time disengaged or watching. Surprisingly, this value is the about same for groups where the females were the majority (3:1) or the minority (1:3). In other words, the presence of males in mixed-sex groups of unequal numbers of males and females negatively impacts female collaborative behavior.

Table 2. Percent of Students Observed to be Watching Passively or Disengaged during more than 25% of the Observations

Group Composition	Sex	Percentage
All groups	(F)	21/84 = 25%
	(M)	30/86 = 35%
2 and 2	(F)	2/12 = 17%
	(M)	4/12 = 33%
Single Gender	(F)	4/28 = 14%
	(M)	10/34 = 29%
Mixed	(F)	20/52 = 38%
	(M)	17/56 = 30%

NOTE: Far fewer females in single gender or evenly mixed groups are watching passively or disengaged as compared with females in unevenly mixed groups, regardless of whether there are more males or more females.

4. DISCUSSION

The most widely adopted implementation "wisdom" presented in the collaborative group learning literature is that group composition should be heterogeneous whenever possible; in other words, learning groups should be diverse in backgrounds, ideas, ethnicity, and gender (Slavin 1995). The common sense idea is that science-friendly students will support and help teach the science-phobic students. However, if the level of student-engagement can be inferred from observed student behavior, the results of this study suggest that successful group compositions might not be best achieved by allowing students to self-form their groups. Unfortunately, we do not know the correlation between student behavior and student performance, but we were able to observe patterns in student behavior related to our goal of having students be more actively engaged in the class. Specifically, females in mixed-sex groups of unequal numbers (e.g., three females and one male or three males and one female) were less likely to display behavior indicating active engagement than females in all-female groups or in groups with equal numbers of males and females. A review of the data in Table 1 reveals that group self-selection led to nearly half of the female students working in groups whose composition was most highly correlated to their disengagement. The level of engagement of male students, on the other hand, does not appear to be related to the sex-composition of their learning groups.

What is now clear to us is that improving the collaborative group learning environment for women in our course requires a focus on group composition. Other researchers have raised concerns about the benefits of heterogeneity in forming groups. Treisman (1992) raises concerns about mixing students of different ethnicity and Wills-Davey (1999) finds difficulties when mixing traditional and non-traditional age college students. These studies, among others, suggest that isolating students with similar characteristics impedes the academic success of these individuals because they can become isolated, distracted, or placed in stereotypical roles even in the small group environment.

Although some researchers present evidence that effective professor-formed groups can be created using pre-test scores (Heller & Hollabaugh 1992), we do not feel that we can "force" student groupings by sex, as our scheme would be blatantly obvious and possibly even offensive to the casual observer. We have begun to make students aware of our results in the hopes that females will self-form female-only groups or equal male/female groups. Informal observations suggest that students have not paid much attention to our *warning*. At the same time, it is not clear what we, as instructors, might do to improve the engagement of female students in unevenly mixed sex groups given the constraints of our large class-size.

Currently, the only major correction we have been able to make is for those students who enroll in the course several days after the semester has started. In these cases, we are able to direct newly enrolled females toward the few female-only groups that exist and direct males away from these groups. Clearly, simply telling our students about our research results is an insufficient intervention, but it is not obvious how to accomplish this without significant investment in directing group formation. In the future, we hope to explore the extent to which our results are specific to non-science majors and the potential for regional and institutional differences. We intend to experiment with other approaches for helping students form groups that encourage active participation by all, with the goal of helping students become more engaged in learning.

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