DETERMINING THE STRUCTURE OF STUDENT STUDY GROUPS

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Although students have reported on their study habits outside of the classroom, there has been little verification of their actual behavior during group study sessions. This project observed undergraduate students studying together outside of the classroom setting in order to determine what study groups formed and what structures described these groups. Elements of social network analysis were employed to identify the groups that students formed. Transcripts of the study sessions were coded and frequency counts were established for each type of student interaction in order to characterize the roles students assumed while studying. This paper discusses the process of identifying the study groups and sets the groundwork for sharing the student roles. One main finding of this work is that the presence of a student recognized as an authority or facilitator of the group impacts the type of conversations that occur in the group setting.

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Introduction

Faculty expect students to spend up to 3 times the number of hours spent in class studying outside the classroom (Wu, 1999). However, little is known about what it looks like when students fulfill this part of didactic contract. Most of the information we do have about student studying behavior is drawn from anonymous surveys and interviews (Thompson, 1976; Shepps & Shepps, 1971; Hong, Sas, & Sas, 2006). Such studies shed some light on what activities students engage in during their study time, but do not verify this self-reported data through observation of the students at work.

Even less is known about student behaviors when the students assemble into self-formed study groups. Although instructors often advise students to study together outside the classroom, they rarely offer guidance to students on how they should structure their study time together or how they should interact with each other while studying. Recently Pazos, Micari, and Light (2010) attempted to develop instruments for characterizing student interactions in a group. Their study, however, relies on the involvement of a peer leader to act as an authoritative director for the group which could impose an underlying structure that might not be present when students form their own study groups and meet outside of class time.

The study presented in this paper undertook the development of a method for observing students as they worked together in self-formed mathematics study groups outside the context of the classroom and endeavored to create a description of what it actually looks like when students are left to their own devices to prepare themselves for exams and homework assignments. The preliminary findings from the data collected in this study will be used to address the following research questions:

1) How do we determine which subsets of students form a study group?
2) What patterns in interactions and roles arise in student self-formed mathematics study groups when they work on homework assignments together?

Framework

Observing students outside of the classroom required an ethnographic approach to the study. This led to the accumulation of hours of video recordings of students studying in addition to accompanying field notes and student journal entries reporting on the session's goals and

accomplishments. The task of analyzing such qualitative data in order to address the relevant research questions led to two main methods of analysis.

Social Network Analysis

Although one may develop an intuitive sense of which students are working together consistently through direct observation, there is enough variation in attendance at study sessions that a mathematically defendable partition is necessary. To this end, the researcher turned to the theories that have been developed for social network analysis.

Treating each study session as an "event," an affiliation matrix can be developed which records which students were present at, or "attended," each event.   From there a co-membership matrix can be developed that identifies the number of events students have in common. Co-membership matrices are susceptible to one-mode analysis techniques such as defining a *clique at level c* where, in this context, "a clique at level c is a subgraph in which all pairs of actors share memberships in no fewer than c events" (Wasserman & Faust, 1994, p. 320).

However, considering a co-membership matrix alone fails to take into account which events were attended by the participants. Thus we also explore the two-mode method of correspondence analysis, which accounts for both the students and the events they attended simultaneously, in order to develop a second perspective of which subgroups of students represent study groups.

Student Interaction Analysis

Identifying the student study groups is only half the battle. A different analysis approach is needed in order to identify the structure of the groups and the roles assumed by students. To develop descriptions of student roles, we created a list of all student interactions, both physical and verbal, and assessed the frequency of certain types of interactions.

Goos, Galbraith, and Renshaw (2002) describe one list of codes they employed while studying student-student interactions in small group work in a high school classroom. Blanton, Stylianou, and David (2009) built upon the work of Goos, Galbraith, and Renshaw by adding new codes in their attempt to develop a framework for analyzing teacher and student utterances in classroom discourse. Both of these sets of codes were used as a base for analyzing the student interactions observed during this study.

Data Collection and Analysis

Participants were drawn from an undergraduate course that blended topics from linear algebra, differential equations and multidimensional calculus. The students in this course represented a variety of majors, from engineering to physics to pure mathematics. Students were chosen from this particular class due to the collaborative emphasis the instructor included as a classroom norm. None of the groups that occurred in the classroom, either inside or outside of class time, were the result of assignment by the instructor or the researcher. All groups were self-formed and self-directed.

In order to capture students studying outside of the classroom, a study space was set aside and equipped with tables, chairs, internet access, and white boards. Students from the class were invited to utilize the space whenever they wanted to study with the understanding that their actions would be video recorded and recorded in field notes by the researcher. Students were also invited to complete journal entries reflecting on their activities during the study session and to participate in up to 3 follow up interviews.

At the end of each study session, students were asked to record both what they worked on and with whom they worked in their journal entries. From these entries, study sessions that focused on reviewing for an exam were separated from study sessions that focused on homework

preparation. These attendance charts were then turned into affiliation matrices, co-membership matrices, and event overlap matrices in preparation for social network analysis techniques.

All study sessions and interviews were transcribed and coded using a combination of Goos, Galbraith, and Renshaw's (2002) coding scheme and Blanton, Stylianou, and David's (2009) coding scheme. While the combination of these two sets of codes encompasses most of the interactions that could be expected, the researcher also employed an open coding scheme in order to add codes as needed should an utterance defy categorization in either of the two schemes. After coding, the researcher determined the frequency of each code per student to establish profiles of what each student's presence contributed to the group and look for patterns in profiles across study groups.

Preliminary Results and Significance

Although the analysis phase is still underway at this time, several observations have been made so far and more are expected to be available soon.

Identified Student Study Groups

The first look at student connections generated from the co-membership matrix yielded 2 easily distinguished study groups along with a solitary individual seen in Figure 1. Using the one-mode analysis of finding cliques at level 3, or imposing the condition that all students in a clique must have at least 3 events in common, generates the colorized graph presented on the right in Figure 1.
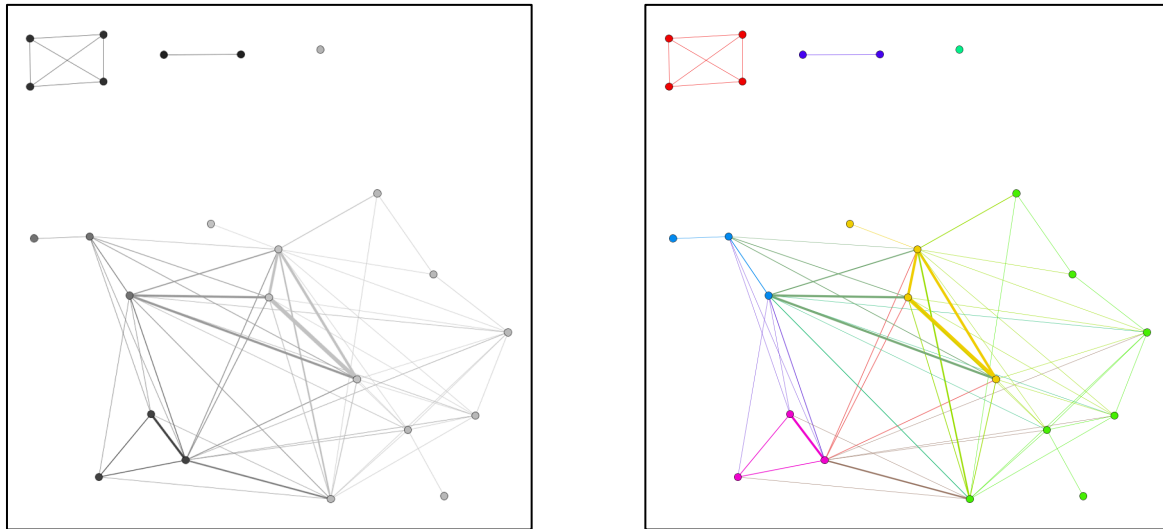

Figure 1. In greyscale, the unaltered graph generated by the homework study session co-membership matrix. On the right, the same graph colorized to show the cliques at level 3.

By requiring students to attend at least 3 events together we cut down on some connections in the largest group that were formed by students who may have dropped in to use the study space and discovered other individuals already present. From Figure 1 it is clear that the large mass of connections can be broken down further into at least 3 distinguishable subgroups depicted in the graph by yellow connections, pink connections, and pale green. Graphical representations of the two-mode analysis are not yet available, but are expected to be ready soon.

Patterns of Interactions and Student Roles

Although the group characterization instrument developed by Pazos, Micari, and Light (2010) is reliant on the presence of an assigned peer facilitator that has already passed the course,

it has much that is in agreement with the data collected in this study. The data suggests that there are several different types of conversations that occur within groups that are dependent upon the presence of a facilitator-type individual, or an individual treated as an authority by the group.

When a student has assumed the role of facilitator for the group or has been designated as an authority by his or her peers, conversations mimic 3 out of the 4 group classifications offered by Pazos, Micari, and Light: *simple instruction* where the facilitator essentially lectures her peers on how to approach a problem, *elaborated instruction* where the facilitator incorporates more conceptual foundations to explain a solution strategy, and *supported discussion* in which the group strategizes a solution but defers to the knowledge of the designated authority among them (2010, p. 194). In the absence of a facilitator, the conversation is often more undirected and includes: *comparisons* of progress made toward a problem's solution either through strategy checks or answer checks, *stagnation* as students with similar understandings can't move beyond a particular issue, and *digressions* that improve social ties among the group but contribute little toward problem solving.

Questions for Discussion

While there are many questions that could be asked of the research at this point in time, I would like to focus on the following:

1) What information about the structure of the study group could be revealed by exploring the subgroup interactions that occur within the group?
2) What other ways are there to create characterization of the roles that may arise in study groups (beyond analyzing frequency of interaction types)?

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