Student-Initiated Study Groups for STEM Classes in Community College Settings

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Abstract

This article describes a focus group research study that examined the experiences of community college students who initiated study groups for science, technology, engineering and mathematics (STEM) courses based on self-identified needs for learning support. Results indicated that students identified early in the semester that they needed assistance with studying, negotiated group roles including identifying a group leader, and utilized technology to communicate and study with group members. Students who participated also believed they benefited from their participation by learning the material from different perspectives, and learning new techniques for studying, but also saw potential negative consequences for students who were not able to join study groups. They recommended that the institutions be more intentional about encouraging students to form study groups, especially in STEM classes.

Keywords: Peer tutoring, Academic support, Collaborative learning, College persistence and retention

1. Introduction

Educational researchers and practitioners have become increasingly interested in improving the academic achievement of students in science and mathematics, often considered gatekeeper courses for college completion, and for entry into the scientific and technical professions (Hurtado, Han, Saenz, Espinosa, Cabrera & Cerna, 2007). Lack of success in completing developmental mathematics courses is also a significant barrier to student success and retention in community colleges (Fike & Fike, 2008; Rodriguez & Cruz, 2009). Peer academic support has proven to be extremely beneficial to students' academic achievement, cognitive development, academic self-efficacy, engagement, and retention to the point that it has become axiomatic (Pascarella & Terenzini, 1980, 1991; 2005;

Sawyer & Berson, 2004). Both teachers and students now widely believe that peer collaboration benefits learning. Various configurations of peer-facilitated small group learning improve academic achievement, enhance learning, create positive learning attitudes, increase application of knowledge, and contribute to persistence in science, technology, engineering, and mathematics courses (Callahan, 2008; Li, Remedios, & Clarke, 2010; Springer, Stanne, & Donovan, 1999).

In community colleges, many of which are commuter campuses that enroll a large number of diverse, first-generation, and nontraditional students, peer academic support can be important to student engagement, social integration, and retention (Clark, 2006; Fike & Fike, 2008; Floyd & Casey-Powell, 2004; Hagedorn, Maxwell, Rodriguez, Hocevar, & Fillpot, 2010; Maxwell, 2010). In fact, peer academic support in class becomes especially important in community college settings because there are fewer opportunities for peer interaction outside of class (Hagedorn, et al., 2010), due to the fact that many students attend part-time (Fike & Fike, 2008). Students with a wide variety of educational backgrounds, like those at commuter and community college campuses, may experience college very differently, may assume that their experience is the norm, may have multiple beliefs about the ideal student, and may not know how to self-advocate in order to meet their own academic needs (Clark, 2006; Kasworn, 2005). Success often rests on their ability to identify their needs early enough to seek help from appropriate campus resources, which many students fail to do (Clark, 2006). Peer academic support can help community college students succeed by connecting them to campus early, creating a sense of belonging, providing instructional support, and learning from other students about success strategies and campus resources (Clark, 2006; Floyd & Casey-Powell, 2004).

1.1 Peer Academic Support in Class

Teacher directed, collaborative, in-class groups have been proven to impact learning in many subjects including biology (Lazarowitz & Karsenty, 1990), chemistry (Weaver, Green, Rahman, & Epp, 2009), mathematics (Fuchs, Fuchs, Hamlet, Phillips, Karns, & Dutka, 1997; Webb, 1991), and computer science (Webb, Ender, & Lewis, 1986), which are often referred to as the STEM subjects, or science, technology, engineering, and mathematics. Institutions of higher education at all levels have also implemented more formal collaborative learning arrangements in the form of cohort-based programs, learning communities, and supplemental instruction for students.

In cohort-based programs, students follow the same course sequence. The cohort model naturally lends itself to collaborative group support. Cohort members learn to navigate the university system while participating in social and academic support activities, building a community of learners through tutoring and instructional support (Flores, Clark, Clayes, & Villareal, 2007). Cohort models designed specifically for community college students have proven to positively impact student success, retention, and graduation rates (Sandoval-Lucero & Chopra, 2010; Sandoval-Lucero, Maes & Chopra, 2011).

The literature on student persistence in higher education also supports the formation of learning communities where students can take linked courses together, and form study teams that can share knowledge, understanding, and responsibility for each others' learning (Abrego, 2008; Flores, et al., 2007; Goldberg, & Finkelstein, 2002; Kanter, 2010; Santiago, Andrade, & Brown, 2004; Tinto, 1998, 2000). Learning communities and supplemental instruction have been associated with higher quality undergraduate education (Flores, et al., 2007; Smith, MacGregor, Matthews & Gabelnick, 2004); higher freshman year grade point averages, and retention (Tokuno & Campbell, 1992). They have also proven a successful academic and social intervention strategy at non-residential community colleges (Goldberg, & Finkelstein, 2002). This is especially true for specific populations, such as English Language Learners who, at the community college level, often get stuck on the developmental education or ESL track never to transition to college level course work (Bernal & Aragon, 2004; Haselkorn & Fideler, 1996; Villegas & Davis, 2007; Rodriguez & Cruz, 2009).

Supplemental instruction is a form of student academic support that uses collaborative learning between successful and struggling students to increase persistence and retention (Arendale, 1994). It is a collaborative learning model that has been in existence for decades and has been used across the P-20 educational system (Arendale, 1994; Gunn, Smolkowski,, Biglan & Black, 2002). Supplemental instruction is most often employed in high enrollment, high failure rate courses in math, science, and English (Arendale, 1994). Collaborative peer-facilitated supplemental instruction has proven effective at increasing the retention and success of provisionally admitted, underprepared, and underrepresented students in higher education (Ramirez, 1997).

1.2 Peer Academic Support outside of Class

In addition to collaborative peer learning structured by the institution, students often voluntarily form study groups (Li, et al., 2010; Sawyer & Berson, 2004). Studies of community college students have determined that over half of the students report participating in study groups, although this was truer of female students than male students

(Maxwell, 2000). Most students believe participating in study groups improves their learning and helps their social adjustment to college (Dennis, Phinney, & Chuateco, 2005; Downs, 1995). In fact, students often report that they prefer learning from peers to learning from instructors (Rourke & Anderson, 2002). This could be because peer learning groups allow for more free and authentic discussion without the evaluative presence and hierarchal dynamic introduced by the instructor (Kremer & McGuiness, 1998; Rourke & Anderson, 2002; Weaver, et al., 2009). Additionally, students often have different perspectives on the course material, and explaining their understanding not only helps others understand, but also strengthens their own understanding (Callahan, 2008; Rourke & Anderson, 2002). Collaborative learning also helps students become more responsible for and actively engaged in their own and other students' learning, which promotes their positive adjustment to college (Callahan, 2008). All these various forms of peer support have been determined to be good predictors of academic success in college, particularly during the first year (Dennis, et al., 2005).

2. Methodology

2.1 Methodology Selection

This study was designed to explore the impact of study group participation and experiences from the perspective of students enrolled in the community colleges with which we work. This research was exploratory in nature, lending itself to qualitative inquiry (Krathwohl, 1998). Because we did not know if, or to what extent, our students voluntarily formed study groups in STEM classes, we chose focus group methodology for our data collection. This choice was made precisely because of the exploratory nature of focus group research designed to help participants explore their experiences and construct new knowledge (Ivanoff & Hultberg, 2006). Questions included how and why study groups were formed, how the students studied, whether physical group contact mattered, how the groups functioned, specific study strategies, study group impact on the classroom learning environment, the role of the instructor and the institution, student success, and attrition from the study groups.

The sampling method for each phase of the study was purposive. The intent of purposive sampling is to find groups of participants in settings where the phenomenon under study is most likely to occur (Denzin & Lincoln, 2000). We invited participation from students in cohorts with whom we worked, and whom we knew were taking classes in science and mathematics during a particular semester after some of our staff members working in student academic support programs experienced a sharp increase in students reporting to us that they were participating in study groups. Participation was voluntary, and participants were ensured their identities would remain confidential. To that end, for the purposes of this article, they are referred to only as students from Community College A or B.

2.2 Institutional Descriptions

Community College A has two campuses located in a diverse metropolitan area. Total enrollment is 11500. Students of color make up 51% of the student body. The city has a large immigrant population which is also reflected in the college's student population. Over 100 different countries are represented among the college's student body. In addition to English, the most common native language of students is Amharic. The second most common native language is Spanish. The college offers large community and college ESL programs. Students can choose from over 40 degrees and certificates in transfer and occupational education.

Community College B is a Hispanic Serving Institution, meaning that at least 25% of the study body is Latino. In fact, Latino students represent 33% of the student body, and students of color represent 57% of total enrollment. Community College B is located on a diverse urban campus and is part of the same community college system as Community College A. Total enrollment of Community College B is 13,000. It offers over 70 degrees and certificate programs in both transfer and occupational education. Community College B also has a Health Sciences Center located on the same campus as one of Community College A's campuses.

2.3 Participant Description

The focus group from Community College A included four students, all of whom were female. Three were enrolled in biology classes, and one was enrolled in a math class. One was Latina, two were African American, and one was White. They ranged in age from 20 to 47 and were planning to transfer to four year institutions, ultimately pursuing degrees in pharmacy, nursing, and biology. All four were native English speakers.

The focus group from Community College B included six students, all of whom were female. All were enrolled in mathematics classes ranging from developmental to college level. Five were Latina, and one was White. They ranged in age from 24 to 35, and were pursuing degrees in elementary and secondary education. Three were completing their college education in their second language.

3. Results

3.1 Students Identified Learning Support Needs Early in the Semester

When we asked students why they chose to initiate a study group, their answers consistently indicated that they knew the materials would be challenging, and they would need support to learn the material. One student from Community College A stated, "I knew going into anatomy that it would be hard, and I wanted to form a study group early on." Another student from Community College A identified a fear of math as a motivator for seeking out a study group. A student from Community College B also indicated that finding peer study group support was a need she identified early in the semester. She describes her experience: "It is another source of academic support and help that I expect when I take a class."

3.2 Proximity Led to Study Group Formation

We asked students how they formed their study groups, and a key aspect of the group dynamic emerged. That aspect was *proximity*. A student from Community College A explained: "I happened to be sitting next to someone in math and we would go to tutoring together." This proximity naturally led to other students forming study groups as well. Another student from Community College A said, "The students sitting next to me, my neighbors, were how the study group was formed." This finding was consistent in both focus groups. A student from Community College B also described the experience of proximity as lending itself to forming a study group, "We sit together in class and study and do homework together." Students also indicated that they liked this natural group better than required grouping. One student from Community College A noted that her self-chosen study group worked better than assigned groups, which she described as "a forced group, like numbering-off."

3.3 Leadership was Important to Study Group Formation and Functioning

In addition to proximity, the identification of a *group leader* was also identified by the students as an important part of study group formation and functioning. A student from Community College A indicated: "A group leader was important to success." The leader was most often a student who appeared to understand the course content. Several students in biology classes at Community College A said they identified the leader by "picking up on who understood the material," and "finding someone who was getting it." Another biology student from Community College A stated, "There was an older woman in the group who became the 'go-to' person. She asked a lot of questions in class, and the entire class seemed to gravitate to her." Students from the focus group at Community College B also identified language proficiency as a selection criterion for the group leader. One stated, "Those who speak English better help the ones who are studying in their second language."

3.4 Building the Group Dynamic Took Time

Although the groups formed early, it took time to work out *group dynamics* and functioning. A student from Community College B noted that it took some time to "break the ice," but after that both the in-class and out-of-class support was helpful. Another student from Community College B also found it helpful remarking, "It helps me learn better rather than studying individually." A student from Community College A commented on building the group dynamic recalling, "Towards the middle of the term the group really solidified. At the beginning some came and went." There was natural attrition in the other groups as well, sometimes due to focus and time conflicts. A biology study group student at Community College A said, "Initially, we had three. One person slowly started getting too social and left the group on her own." Students also left the group if meeting times did not work with their schedule.

The study group members also noted that, at least initially, meeting was an important part of effective group functioning. A student from Community College A stated: "Without physical group contact, it might not work." Another student from Community College A described the initial group experiences: "We needed to get together in the beginning, but then could use other formats to meet."

3.5 Study Groups Enhanced Learning and Increased Accountability

Not only did students initiate the formation of study groups, they also felt that participating in the group enhanced their learning, their commitment, and taught them new learning strategies. One student from Community College A said that she initially resisted the idea of flashcards, but the group leader convinced her to try it. She described the experience: "She pushed me to do more and to try new things and ask more complex questions. I didn't think flashcards would help me at first, which was really just an excuse. She taught me that they were helpful."

Other students acknowledged that each student in the group had different expertise to contribute to enhanced learning. A student from Community College A shared her experience: "People seemed to understand different concepts, so everyone shared what they knew." A student from Community College B agreed stating, "It allows me

to communicate and gather new and more information." One strategy that study groups used that seemed to capitalize on their varied strengths and understandings was described by a student from Community College A: "[Group members] would take an assignment home and do them individually, and then come back and check our work as a group."

In addition to different students offering varying perspectives and techniques that enhanced learning, their participation in the group also strengthened their commitment to completing the course. A student from Community College B explained this phenomenon: "Support is what helps. Being accountable to others keeps you accountable to yourself." Another student from Community College B also appreciated the supportive aspects of the study group, "Whenever we have met they have emphasized that they are there for academic and moral support. It is very helpful to me."

3.6 Students Used Technology to Connect with the Study Group

One interesting aspect of the study group function that emerged at Community College A was the use of technology as a meeting and study tool. One student from Community College A said: "I didn't want to drive to [the college] for a study group so we used our phones to study." While all the groups did get together physically some of the time, especially at the beginning of the class, they used other formats to connect. They noted that they scheduled regular times to meet after class. One student explained, "If someone couldn't stay, group members would call each other to get caught up." Phones, email, and texting were all mentioned by students in groups at both Community College A and B as a means for communicating with study group members outside of class. They even used their smart phone applications as study tools. One student from Community College A discussed a phone application called Flashcards A++. She recalled, "Anyone that had the app could use it to see other people's flashcards." She also noted: "The process of actually making the flashcards on the phone was helpful."

3.7 Study Group Formation Can Impact the Classroom

Students in both focus groups believed that participating in study groups enhanced their classroom experience. A student from Community College A stated: "It made me want to go to class." Another believed the group helped her "have deeper relationships with classmates." The study groups also helped students with feeling more comfortable in the classroom. A student from Community College A discovered after participating in the group that others had questions too; she wasn't the only one. She said: "Initially people don't speak up in class so you feel like everyone else gets it." This sentiment was echoed by a student from Community College B: "The benefit of having my classes with study group members has been *essential* to my success in class." A second student from Community College B agreed, and remarked: "We work well together in the classroom." The study group also helped students to make other connections that support their success in class. A student from Community College B described the benefits: "I really enjoy having class with my group. It has helped me with everything from car-pooling to completing assignments."

However, there were some perceived less desirable impacts of study groups in the classroom. A student from Community College A noted: "The groups could be seen as cliquish." Students noticed "tight boundaries around groups." Another student from Community College A felt the difference in classes where study groups were and were not initiated by students: "Without [a group] you don't feel like you belong; don't even want to go to class. In one class, I didn't understand and didn't have anyone to talk to about it." These impacts were also felt by students in Community College B. Some were not able to take classes with the cohort due to previous college experience, thus could not form study groups with them. One student explained, "I am a little further ahead in the program. I have not had the opportunity to study with others, but I know the other participants enjoy it very much, and if they need help, they know they can look to each other." Another wished for the opportunity: "I am aware that this is possible, but I haven't had the opportunity. I think I have missed out."

3.8 Support from the Instructor Varied

The focus groups confirmed that the initiation and maintenance of the study groups was more student driven than instructor driven. There were supportive instructors. Students from a Community College A biology and a Community College A math study group indicated that their instructors were supportive. One biology student said: "I had a supportive instructor. He would joke that we were the first ones there and the last ones to leave. He was very aware of our effort." The math study group at Community College A had support as well. A student from that group stated: "The teacher encouraged groups. The instructor would then stick around after class and help students." Students from Community College B also indicated instructor support. A student from Community College B was very emphatic, "Our instructors have not only done their job effectively, they have gone above and beyond their call of duty to provide both academic and moral support to our groups." However, not all students who participated in student-initiated study groups had the same experience. One student from Community College A noted: "[Our

instructor] knew about the group, and was sort of encouraging." Another student also noticed less than enthusiastic instructor support saying that the instructor stated, "You can get into groups or not, it's up to you."

Their recommendations were that instructors be more intentional about encouraging students to form groups. They thought instructors should allow time in class for students to get to know each other so they would feel comfortable forming groups. Students from Community College A believed that assignments in math and science classes lend themselves to group work. One student who specifically described the experience in a previous semester of computer classes being isolating recommended that "instructors should have everyone get close to the front of the class so there are no empty seats to encourage students to get to know each other." Interestingly, instructors who we contacted were supportive of the idea of study groups and were willing to encourage them early in the semester. However, their attempts to encourage students in their classes to initiate them and report back on how they were going were not very successful. Instructors believed that the study groups should be student-initiated and student-led.

4. Discussion

This study confirmed previous research regarding the academic and social benefits of collaborative peer learning for STEM classes (Dennis, et al., 2005; Li, et al., 2010; Pascarella & Terenzini, 1980, 1991; 2005; Sawyer & Berson, 2004; Springer, et al., 1999). Participation in study groups helped students in this study persist and achieve in their mathematics and sciences classes. This study also supported previous work on the ability and interest of community college students forming self-initiated study groups (Hagedorn, et al., 2000; Maxwell, 2000). The fact that all the focus group participants were women also confirmed previous research which determined that women community college students were much more likely to participate in these types of informal learning activities than men (Hagedorn, et al., 2000). These study group experiences that support the success of students who were diverse, non-traditional, second language learners, attending open access institutions, confirm the effectiveness of collaborative peer learning for at-risk and underrepresented students (Li, et al., 2010; Ramirez, 1997).

Our study also brought to light some additional information that could be of interest to both practitioners and researchers. That the students used technology, including smart phones, email, and texting to communicate and study, sometimes in lieu of meeting face-to-face, is important to consider. One student even used a smart phone application, Flashcards A++, to put a modern spin on a tried and true study technique. Researchers have determined the effectiveness of peer collaborative groups aided by technology in online environments (Rourke & Anderson, 2002). However, the infusion of technology-based study tools and techniques into a traditional face-to-face course emphasizes the level of comfort and proficiency today's student has with technology. Previous studies of traditional age college freshmen indicated their interest in using cell phone technology as an educational learning tool (Humble-Thaden, 2011). However, we must consider that most of the students who participated in the focus groups were of non-traditional age. As practitioners, we cannot overlook the importance of encouraging our students to collaborate, using the technology that is available to them.

Additionally, the importance of leadership for effective group functioning is a key finding from this study. The students naturally gravitated to those in class who showed mastery of the subject matter and leadership qualities in forming their study groups. The groups also functioned better with leadership. While there has been some preliminary research on negotiation of roles and leadership in college study groups (Lazar, 1993), it was conducted at the graduate level. There has also been research on the student-initiated group management strategies, not specifically leadership, impact on positive group working experiences in higher education (Cumming, 2010) As such, this finding presents an avenue of future inquiry for researchers on student academic success in higher education.

Finally, the potential negative aspects of student-initiated study group formation need to be examined. From a practitioner perspective, these potential negative consequences revealed by the students in our study need to be considered in order to develop strategies to minimize or mitigate negative impact to students who don't participate in study groups, while still encouraging the practice as it does positively impact learning. From a researcher perspective, the potential negative aspects could be studied to determine if there are any impacts on student learning, achievement, persistence, and self-efficacy for those who do not participate in study groups.

5. Conclusion

Overall, our study confirmed that community college students enrolled in STEM classes do initiate study groups, and from the student perspective, these groups improve their engagement, learning and achievement. The students in the study also indicated that participating in study groups helped increase their level of confidence and comfort in the classroom, indicating both academic and social benefits of study-group participation. Students in this study were able to identify their learning support needs early in the semester, identify students who could support and assist their learning, negotiate group membership and roles, and implement technological strategies and tools to stay

connected with study group members. Further research on the need for, and nature of study group leadership would contribute significantly to the literature on student-initiated collaborative peer learning.

We also need to highlight the fact that students who participated in this study were not the typical population of students who enroll in mathematics and science classes at the college level. Unlike their counterparts at universities, they were not White and Asian males of traditional college age (Callahan, 2008). They were diverse, female, and predominantly of non-traditional college age. However, like their peers in other studies, they benefited both academically and socially from collaborative peer academic support in science and mathematics classes (Fuchs, et al., 1997; Lazarowitz & Karsenty, 1990; Weaver, et al., 2009; & Webb, 1991) at all academic levels including developmental education. This study thus, provides evidence that academic-centered peer support is beneficial to a broad cross section of student types and demographics delivered in a variety of higher educational settings.

However, the potential negative aspects of peer study groups identified by the students in our study also point to an important area for further investigation in order to maximize the benefits and minimize the detractors of collaborative learning efforts for a wide variety of students in STEM classes in colleges and universities. Further study in this area will help to implement the most effective peer-collaborative learning supports and configurations that will assist institutions in achieving the college completion goals, contributing to the workforce needs of our communities and nations.

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