Benefits and Challenges of Assigned Out-of-Class Group Work in The Community College Setting

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Abstract
In this pilot study, students in Anatomy and Physiology courses at a Southwest US Community College were assigned to groups with the instruction that they must meet outside of class time to work on course assignments throughout the semester. The assignments included exam preparation questions and case studies, but the groups could use their out of time class in other ways as well. The aim was to identify student-perceived challenges and benefits associated with out-of-class group study in a population of commuter students. The majority of students reported group participation was beneficial to learning while also noting the challenges in scheduling regular face-to-face meetings, which were often mitigated through technology use. The majority of respondents (70%) commented that they would seek other group study opportunities in their courses. In this qualitative report, we conclude that students perceived group work to be beneficial enough to seek additional group study opportunities in spite of the logistical challenges associated with a commuter population.
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Key words: group work, community college, reflection, peer teaching

Introduction
Anatomy and Physiology (A & P) is generally considered to be a gateway course into the health sciences, in that it is both foundational for future course work and has a high failure and withdrawal (DFW) rate (Koch 2017; Lundsford and Diviney 2020; Levin and Kater 2018; Steinberg, 2001; Center for Community College Student Engagement, 2016; Grimes, 1997). Poor academic preparedness has been implicated in the high attrition rate, which, in turn, reflects multiple academic and non-academic factors (Grimes, 1997; Paulson 2012; Stewart et al. 2015). However, even when controlled for academic preparedness, Minoritized Students in STEM, under-represented ethnic minorities, first-generation, and/or lower socioeconomic status (MGS), have disproportionately high failure rates in gateway courses (Koch 2017; Harris 2020). This issue is especially important in community colleges, given their large proportion of underrepresented students (Radwin et al. 2018).

Much of the difference in achievement is reflected in the makeup of the Latinx student population, with the National Center for Education Statistic's 2015-2016 study on National Postsecondary Study Aid reporting that they compose 26% of the student population in 2-year colleges compared to 14.8% of the population in four-year colleges (Radwin et al. 2018). Encouragingly, the work of Harris et al. (2020) suggests that closing this achievement gap for MGS may have a disproportionately large (and beneficial) impact on student attrition. Incorporating evidence-based, active learning practices such as small group work has been shown to reduce the achievement gap in MGS when accompanied by inclusive practices (Theobald et al. 2020). Thus, optimizing teaching and learning in and out of the classroom is a necessary step to address the achievement gap between overrepresented and underrepresented students (Benismon 2005).

Making the conversion from a lecture-only pattern of course delivery to one that contains evidence-based practices takes significant effort, but can be done incrementally, with new additive features each semester or year (Tharayil et al. 2018). Such activities might focus on alternative/additional explanations, increasing time on task, supporting a higher level of motivation or incorporating a greater number of peer-to-peer interactions. As this project focuses on a community college population made up solely of commuter students, we focused on increasing peer-to-peer interactions outside of class time through the implementation of group work. Group work has been shown to enhance student performance because group members can divide the task of understanding and grasping relatively difficult concepts among several people, who then exchange their expertise in their own parlance (Miner et al., 2005; Treisman, 1992; Springer et al., 1999; Brame and Biel, 2015).

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A significant proportion of our community college entrants are of mature age and are often returning to school after an extended hiatus from any formal educational setting. Students coming back to school benefit from cooperativity within the classroom. Philip Uri Treisman (1992) observed that students who studied in groups performed better in calculus. This observation in itself is not earth-shattering. However, the reason that those who study by themselves tend to underperform is an eye opener. What Treisman saw was that students who studied alone were more engaged in checking answers in the back of the book than actually trying to critically evaluate the questions and the underlying concepts. This, of course, was a result of their focus on grades. What was also significant in this finding was that these students never discussed their studies with their peers. As they performed poorly in face to face tests, they became discouraged and did not talk very much about their academics amongst themselves. Their individualistic approach to studies prevented them from knowing that other students were also suffering from similar anxieties. As anxiety grew, it prevented them from seeking help from their peers and/or their TAs or instructors. In contrast, those who studied in groups extended the discussion of their classroom topics into their social life and shared their understanding among themselves. Effectively, they were teaching each other the concepts outside of the classroom that might have been difficult in the classroom.

We are interested in an overall outcome of preparing students to gain the agency of self-learning they can utilize in college courses as well as in their careers. One model for this skill development has been presented by Miner et al. (2005). It involved developing a framework that "bridges the gaps between learner needs, learning objectives, delivery of instruction, and evaluation" (Miner *et al.*, 2005). In order to build toward this model, it is helpful for students to create methods of evaluation that include feedback from their peers and not just their instructor. This may be accomplished through the use of cooperative learning based on constructivism and social interaction (Treisman 1992; Bransford, et al. 2001, Johnson, et al. 2014). This feedback does not have to be graded; it just needs to be a meaningful part of the formative process. One way to do this is with the implementation of small groups in which students are able to both listen and be heard as they critique or support each other's work.

Group work is not uncommon in college STEM classes, where it is often a required part of a course (Oakley et al. 2004). Out of class groups sometimes form organically, at least in residential populations. Rybczynski and Schussler (2017) surveyed students at mainly residential colleges and found that 59% reported voluntarily forming study groups in science courses. However, the uniqueness of the community college population makes it arguably more challenging to have productive group meetings outside of class because of reduced proximity during non-class hours and the work and family schedules that are often involved. The overarching aim of this study was to investigate if mandated out-of-class group work could reasonably be instituted in this population, how these students would perceive the benefits and challenges of working in groups, and whether it would impact academic achievement on exam scores.

Methods

Group Work

In spring semester of 2019, two sections of a Human Anatomy and Physiology II course (n=32 students total), taught by one of the authors (HSR) at the New Mexico State University – Doña Ana CC, implemented formal student groups. To create the groups, a pre-test assignment was administered after which groups of three to four students were randomly formed by the instructor with the one criterion that each group contained at least one student who scored at least a "B" grade on the pre-test. Each group of three to four students was instructed to work together at least once per week outside of class, either face to face or virtually, as per their convenience. The group work included pre-laboratory activities and case studies. Students were also encouraged to help each other master difficult topics. In class, students generally worked together for 10 to 15 minutes per lecture in their respective groups.

Assessments

Assessment grades were never shared amongst group members. All student scores were individual, but there was often an opportunity to discuss expected content with group members immediately preceding the assessment. For example, during lectures students used "clickers" to respond to questions. The students were given the opportunity to confer within their respective groups before they answered. Similarly, laboratory activities were always conducted in the assigned group, but weekly laboratory quiz assessments were individually completed. Immediately prior to taking the laboratory quizzes, students were allowed to discuss concepts and content within their groups, with the intent that they could clarify their understanding on items they were still unsure about prior to taking the quiz. Table 1 shows the assessments for the semester.

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Assessments and Frequency or Number	Description of the assessments	Allocation of grades
Homework (Weekly)	Reading and embedded follow up questions for each chapter.	20%.
Chapter Exams (4)	Four exams covering multiple chapters administered via canvas.	20%
Lecture Quizzes (5)	Five lecture quizzes as described in methods	12%
In-Lab Quizzes (weekly)	Eleven lab quizzes during the semester with one lowest score dropped from the grade.	10%
Lab practical exam (1)	Lab Practical exam consisted of identification of tissues, functions, and circulatory routes.	10%
Comprehensive Exam (1)	Comprehensive	15%
Weekly reflections (weekly)	See methods	5 %
Final Reflection (1)	See methods	5%
Class Participation and Clickers (weekly)	See methods	3%

Table 1. *Breakdown of Semester Evaluations*

Lecture quizzes were also preceded by group discussions with groups guided by prompts provided by the instructor. The following provides an example set of prompts:

"These are likely question topics for this Lecture Quiz (#1). You have 20 minutes to study these concepts as a team. After the discussion is over, I will hand you the test and you will answer the questions individually. The test time will be 25 minutes.

1. What are the functions of blood? How are they responsible for the maintenance of homeostasis?
2. What are the components of blood and what are their characters? For example, what is the difference between a lymphocyte and neutrophil; between plasma and serum; between platelets and the rest of the formed elements, etc.?
3. How is a mature RBC different from other cells? What is the significance of that feature?
4. What happens to the hemoglobin of an RBC when the cell reaches the end of its useful life?"

As part of their group study outside the classroom, students were engaged in an interrupted case study on cardiovascular and respiratory physiology. Two of the lecture quizzes included questions from the case study.
Each week, students wrote a reflection paragraph describing how their group work went for that week (5% of final grade). Every other week group members completed a short survey assessing group functionality. At the end of the semester, each student also submitted an end of semester reflection (worth 5%) on their overall experience using the following prompts:

1. During the semester, how engaged have you been with your group?
2. What did you find most helpful about group interaction in learning?
3. What did you find least helpful in learning within your group?
4. What steps did you take, or attempt to take, to address any roadblock ingroup learning?
5. What might/could you have done better?
6. What could your instructor have done more to facilitate the group's engagement?
7. How likely is it that you will try to form or belong to a group for your other courses in the future? Please describe your rationale for this decision.

Academic scores from unit quizzes and the final, and total D/F/W rates were compared to those who took the course a year prior (spring 2018, n=22 students) in which formal groups were not implemented. Student scores from spring 2018 and spring 2019 were compared with an unpaired t-test and D/F/W rates were compared with Chi square analysis. A $p<0.05$ was considered significant. Additionally, a concept-wise comparison was made for the nine concepts (instructor defined) tested on the final exam.

Thematic Analysis
We undertook inductive thematic analysis of the final reflections similar to that employed by Farr et al. (2020). In summary, end-of-semester student reflection essays were subjected to thematic analysis by two reviewers who were not involved in course delivery. Themes and keywords were

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identified by each reviewer after a first read of the reflections. Counts were generated for each theme based on a second read. After coding, the results from each reviewer were compared for consistency. The percentage of respondents was determined by calculating the number out of the 30 students that completed the end-of-semester reflections, whether they addressed a specific prompt or not. The percentages do not necessarily sum to 100% because some students included more than one theme in their reflection and others may not have addressed specific prompts in their reflection.

Results

Demographic Information

Table 2 summarizes the demographic data from the 2019 cohort, in which group work was mandated, and the 2018 cohort in which it was not. The 2019 data reflects the students who started the courses, of which three dropped prior to the end of the course. Of the 34 that finished, 30 completed final reflections. The 2018 cohort data also reflects those that started the course.

	2019 Cohort n=37	**2018 Cohort n=30**
Commuters (%)	100%	100%
Gender	76% female 24% male	66% female 34% male
Ethnicity	78% hispanic 16% white 6% other	73% hispanic 20% white 7% other
Ages	18 = 6 19-22 =21 23-27 = 4 28-33 = 3 30-39 = 2 >40 = 2	18 = 0 19-22 =12 23-27 = 13 28-33 = 4 30-39 = 3 >40=0

Table 2. *Demographic data*

Thematic analysis of student reflections

Thirty students submitted final reflections, with most addressing the prompts. Table 3 shows the identified themes associated with the prompt "during the semester, how engaged have you been with your group?". A total of 24 unique students (80%) reported engaging meaningfully with their assigned groups. Of the six students (20%) that did not find their assigned groups useful, two noted that they "unofficially" joined a different group instead.

Theme	**Explanation**	**Trigger Words**	**Sample Comment**	**Count**	**% of Respondents**
Engaged in face-to-face meetings	Students met regularly in face to face groups.	• in-person • face to face • met regularly	"I actually liked having the groups. I was hesitant at first, because I like to work by myself usually but it was nice to be in a group. I was very engaged with my group, we had good communication."	16	53%
Engaged via technology	Students interacted regularly via Skype, Canvas, text, email, Google docs, etc.	• Canvas • Texting • Skype • Email • Google Doc	What we used the most was google docs, and this was how we would study for upcoming quizzes, we would put in our own inputs for each topic/question.	13	43%
Not very engaged	Students did not have regular, meaningful interactions outside of class.	• Own • Myself • Self • Discouraged	The members of the group found it difficult to coordinate schedules, and eventually lost interest in even attempting to meet up.	6	20%

Table 3. *Themes associated with the prompt "During the semester, how engaged have you been with your group?"*

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In response to the prompt "what did you find most helpful about group interaction in learning?", 18 students (60%) noted that alternative explanations or strategies were beneficial. Less frequently themes included: peer teaching (n = 8, 27%), preparing for exams (n=6, 20%), motivation (n=6, 20%) and splitting the workload (n=2, 7%). These results are summarized in Table 4.

Theme	Explanation	Trigger Words	Sample Comment	Count	% of Respondents
Peer Teaching	Student benefits from participating in peer teaching.	• Teach • Help • Peers • Group members • Explain • Get/Ask for help • Learn • Understand • Educate	"…[T]ogether you can help group members understand a topic they were struggling with."	8	27%
Diverse learning Strategies/ perspectives	Student benefits from being exposed to the diverse learning strategies and perspectives of their peers.	• Different/new • Learning strategy • Approach • Way • Understanding	"Each individual has different learning strategies, so when you have a group everyone tends to pitch in and we use different methods for studying."	18	60%
Split Workload	Student benefits from sharing the course workload.	• Workload • Lighter • Split • Divide • Share	"Another helpful factor was making the workload lighter. Since we split up the questions on the study guide, it gave me more time to actually study the material, instead of only having time to find the answers."	2	7%
Exam Prep	Student benefits from being in a group to study for upcoming quizzes/tests/exams.	• Exam • Tests • Prepare • Study • Memorize	"…[T]hat it was helpful in that fact that we both would gather information on the topics we had to study and as well as getting a better grade on the quizzes or the exams."	6	20%
Group Motivation/ Accountability		• Motivate • Accountable • Encourage • Engaged	"I motivated them to study through our conversations on Skype. We made it like a competition when we were answering questions."	6	20%

Table 4. *Themes associated with the prompt "What did you find most helpful about group interaction in learning?"*

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An inability to find a common time to meet was the most mentioned theme (n=25, 83%) in response to "what did you find least helpful in learning within your groups?". Other themes included group effort imbalance (n=7, 23%), a decline in motivation over the terms (n=6, 20%) and stress induced by group work (n=6, 20%). These results are summarized in Table 5.

Theme	Explanation	Trigger Words	Sample Comment	Count	% of Respondents
Organizing/ Scheduling Issues	Student experiences issues organizing and/or scheduling in person or online group meetings.	• Different schedules • Conflicting Schedules • Work Schedule • Personal lives	"I was kind of discouraged about the group study sessions because either one of the group members was never available to meet and the other had a busy schedule for work."	25	83%
Group Effort Imbalance	Student experience an imbalance of effort between group members.	• Time • Energy • Work • Unfair • Unmotivated	"What I found least helpful in learning in groups was that some group member at times didn't put out the same energy as other."	7	23%
Decline in Motivation over the Term	Student notices a decline in motivation to work in groups either themselves or their colleagues throughout the semester.	• Worked harder • Lost/lacking motivation	"I also noticed that most group members tried harder at the beginning of the course than at the end."	6	20%
Stress/ Anxiety	Student experiences stress or anxiety due to being placed or having to work in groups.	• Worried/worry • Anxious • Out of place • Awkward • Shy • Stressed • Guilt • Insecure • Pressure	"When I found out we were going to be placed in groups, I was worried. The questions went through my mind about who is going to be in my group, do they work hard, and are they responsible. I also feel out of place since I'm older than most of my fellow peers."	6	20%

Table 5. *Themes associated with the prompt "What did you find least helpful in learning within your groups?"*

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Table 6 shows the themes that emerged from the question "What could your instructor have done more to facilitate the group's engagement?". Two common themes emerged: 1. that students would benefit from more group time in class (n=10, 33%)) and 2. that many students wanted to choose their own groups based on interests and schedules (n=9, 30%).

Theme	Explanation	Trigger Words	Sample Comment	Count	% of Respondents
In-Class Group Meetings	Student believes students would benefit from in-class group meetings.	• Time in class • Group assignments in class	"What would have been helpful from the professor is by giving us some time in class to meet as a group."	10	33%
Choose Own Groups	Student believes that students would benefit from being allowed to choose their own study groups.	• Choose own groups • Pick own groups	"I believe that the instructor could have gave us a week to pick our own groups to meet people in the class to figure out other people schedules and pick the groups by which people would work better together."	9	30%

Table 6. *Themes associated with the prompt "What could your instructor have done more of to facilitate the group's engagement?"*

When asked how likely students would be to form or belong to a group in their other courses, 21 (70%) responded affirmatively, two (7%) were unsure, three (10%) reported that they were unlikely to join other groups and four (13%) did not address this prompt. These results are summarized in Table 7.

Theme	Trigger Words	Sample Comment	Count	% of Respondents
Very likely	• Absolutely • Yes • Very likely	I would like to seek out study groups of like-minded individuals in future courses because the whole idea just makes sense, you review a topic and your peers review a topic and then you reinforce the concept together, it's ideal.	21	70%
Unsure	• Depends • Maybe • Probably • Possibly	I will like to try this in other classes, but I'm a really shy person, I don't know if I could have the strength to ask people if they want to do a group study.	2	7%
Not likely	• Unlikely • Doubtful	If I have the choice to not be in a group, I will probably not join and just do things on my own	3	10%

Table 7. *Themes associated with the prompt* ***"****How likely is it that you will try to form or belong to a group for your other courses in the future?****"***

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Fewer students (n=14) directly responded to the prompt "what steps did you take, or attempt to take, to address any roadblock in group learning (data not shown). Of these 14, 11 indicated that they attempted, or used, technology to adapt to scheduling challenges and three adjusted their own schedules. In response to "what might/could you have done better?", 11 students noted that they could have studied more, six students indicated they could have planned more in-person meeting times and four students wrote that they could have switched groups (data not shown).

Assessment Data

Combined non-final assessment scores (lecture quizzes, lab exams, lab quizzes) for the 2019 cohort were 62 ± 18% which did not differ significantly from the 2018 cohort scores of 58 ± 10%. The final exam score in 2019 of 45 ± 12% was significantly less than the 2018 score of 56 ± 10%. Figure 1 shows the comparison of summative assessments between the two cohorts. D/F/W rates were not different (p=0.38), with a rate of 33% in 2018 and 27% in 2019. Final exam concept comparisons showed that 2019 students did not perform better than the 2018 students in any of the none concept categories included on the exam. These results are summarized in Table 8.

Concepts	**% correct in Sp2018**			**% correct in Sp2019**		
	SectionD01	Section D07	Total	Section D01	Section D07	Total
Cardiovascular Physiology: Blood	55	43	49	42	41	41.5
Cardiovascular Physiology: Heart	59	73	66	40	45	42.5
Cardiovascular Physiology: Circulation	47	42	44.5	41	45	43
Respiratory Physiology	42	50	46	43	42	42.5
Immunology	58	61	59.5	46	53	44.5
Digestive and metabolism	54	47	50.5	43	41	42
Renal and Electrolytes	67	68	67.5	51	43	47
Reproductive	56	54	55	44	46	45
Genetics	45	54	49.5	30	45	42.5

Table 8. *Concept-wise analysis of student responses in Final Exams 2018 vs 2019*

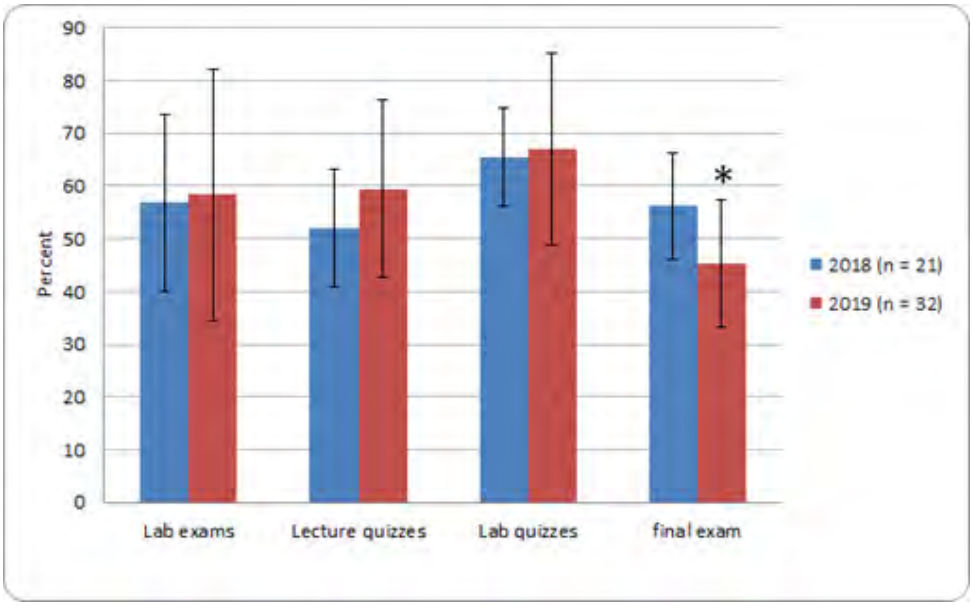

Figure 1. *Comparison of summative assessments and the final exam scores between Spring 2018 and Spring 2019*

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Discussion

While the volunteer use and student perceptions of out-of-class group study has been previously described in a mainly residential population (Rybczynski and Schussler 2017), scant data, if any, exists about its implementation in the community college setting. This study aimed to determine if such a requirement was feasible in a class populated by commuter students and to assess the student perceived benefits and challenges of group work implementation. The main finding is that 70% of students reported that group study was beneficial and that they will seek similar opportunities in other courses even though they faced scheduling challenges with their out of class implementation. This contrasts with the 10% of students indicating they will not seek future opportunities to participate in group work.

Though student reflections perceived learning benefits from group study, academic achievement scores and D/F/W rates showed no positive changes in the class that implemented group work compared to a previous year's course. In fact, final exam scores were lower in the cohort that included group work in spite of no changes on semester quiz or unit exam grades (all individually earned) compared to the prior year. Other studies have similarly documented positive student perceptions towards the use of study groups without improved performance (Chang and Brickman, 2018; DeVoe et al. 2009; Farr et al. 2020; Rybczynski and Schussler 2017). In contrast, studies of peer assisted learning, in which peers who had successfully completed the course facilitate out-of-class group activities, have been shown to close the achievement gap for underrepresented populations in gateway STEM courses (Finn and Campisi 2015; Arendale 2014). This approach may, however, be difficult to implement in the community college setting. Moreover, the data from the current study should be interpreted cautiously because of the small subject numbers and lack of ability to control for student academic backgrounds. Larger and better controlled study populations would likely be necessary to address the academic impact of the mandated group work.

End of course student reflections from the 2019 courses were rich with information about their experiences and perceptions of group study. Although there were many challenges associated with implementation, including work schedules, long commutes, family obligations, students leaving mid-semester, etc., the overall perception was that it was a beneficial experience. The majority of the respondents reported to have engaged in group study either in person (face to face) or via technology. These latter included text and email chains, LMS resources, Google docs, and Skype. Such engagement led to several student-reported benefits including "peer teaching", "diversity in learning strategies", "workload distribution" and "motivation". This list is similar to those reported by other studies that looked at student group interactions. For example, Farr and her co-investigators (2020) reported that cooperative learning via teacher intervention resulted in students hearing multiple explanations, McCabe and Lummis (2018), found that 67% of students participating in groups found them to be motivating, and Rybzynski and Schussler (2017) noted two dominant themes in their survey of students: 1. students used groups because of a desire for clarification or help, and 2. students perceived a benefit from social learning. Group work may also have helped create a better sense of community, which is often lacking in Anatomy and Physiology and other gateway courses (Finn and Campisi 2015).

Not all students reported a beneficial experience. Those that did not, often cited an inability for group members to be motivated enough to find a common time, or reasonable technology, to promote suitable group function. A lack of contribution, or effort, by one or more group members was also reported as a problem. Such findings are also similar to the lack of productivity or slacker members reported by students in other studies (Rybzynski and Schussler 2017; Oakley et al. 2004). Such experiences can lead to negative attitudes toward groups. However, even facing group failure, a couple of students in the current study took it upon themselves to join other groups that they found to be a better fit or more highly functioning. This infers they were motivated to participate in group work.

In this study, students were provided little guidance about how to function as a group. This is in contrast to many implementations of student groups where the faculty assigns roles such as group leader or note-taker and may even provide a contract to be signed by group members that conveys expectations of group behavior (see Oakley et al. 2004 for detailed discussion on recommendations for managing groups). In our case, outside of class group interactions were neither directed nor monitored by the instructor, although there was some motivation to meet because of the assigned regular reflections about group functioning.

In summary, students generally met because they perceived a benefit from doing so. Such positive responses were not necessarily expected because of the many time and transportation constraints experienced by the community college student populations. Additional study will be necessary to determine the most effective means of implementing out of class group work and to determine the impact of such interaction on academic performance in this population.

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Back to TOC