GROUP DYNAMICS IN A CADAVERIC LABORATORY: A CASE STUDY FOR INSTRUCTIONAL PRACTICES

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ABSTRACT

This study investigated small and large student group dynamics, personal development, dissecting experience, and learning approaches in cadaveric laboratories at Colorado State University and Rocky Vista University. Student interviews (n = 20) and a case study with thematic analysis were performed in conjunction with Forsyth's conceptual framework on group dynamics. Results indicated that both group sizes offer unique benefits and implications. The majority of participants were pleased with their group members in both the small and the large groups but preferred not to study (n = 13) or spend their free time together (n = 15). All the students in the small groups (n = 14) stated that they underwent a change in their development as a group member and many modified their learning strategies. Overall, students from both groups appreciated a smaller student-to-cadaver ratio as it provided more time to dissect and greater opportunities to engage with the material. This study generated findings critical for the understanding of how group work and the selection of group size in the cadaveric laboratory affect students in their learning approach, dissecting experience, and personal development. It offers a critical lens for restructuring curricula and incorporating effective methods into the scientific classroom. Educators teaching in any group setting should consider these effects to evaluate which group size will generate the desired results for their corresponding curriculum.

Keywords: group dynamics, anatomy instruction

INTRODUCTION

In scientific classrooms, group work has been extensively evaluated and is nowadays one of the most widely used teaching approaches (Wilson et al., 2018). It can promote student collaboration and even improve students' attitudes towards the subject (Johnson & Johnson, 2009; Johnson et al., 2014; Springer et al., 1999; Tanner et al., 2003). Additionally, it provides opportunities to develop teamwork and conflict resolution skills and to receive feedback from peers and instructors (Johnson & Johnson, 2009; Lamm et al., 2012). In contrast to that, ineffective group work could result in a learning barrier and unequal workload among all group members that could eventually influence the quality of the work (Feichtner & Davis, 1984). The measured benefits and implications of group work have outweighed the negative results and thus been used to change existing scientific curricula, especially within undergraduate courses.

However, in a graduate or professional level cadaveric classroom, different pedagogical approaches have been studied and assessed over the past decade. The literature has focused on measuring students' perceptions of different online anatomy software (Mathiowetz et al., 2016), integrating anatomy and physiology lectures and laboratories (Peacock et al., 2020), learning anatomy from prosected cadaveric specimen versus plastic models (Mitrousias et al., 2020), and flipped

classroom approaches (Fleagle et al., 2018). Most studies collected quantitative data such as student outcomes and qualitative data in the form of surveys and interviews to effectively increase content delivery and students' knowledge acquisition in the classroom. However, when reviewing the literature, there is a lack of analysis of group dynamics and the effects of different group sizes. It remains unclear what additional skills students acquire or if they experience a change in personal development and learning approach while being exposed to different group sizes in human anatomy.

In general, group dynamics are the influential, interpersonal processes that occur in the individual group as well as between groups over time (Forsyth, 2014). These processes determine how members interact with each other and what actions are taken. Aspects like peer pressure and support, power dynamics and leadership, goals and motivations, and the structural properties of the group are important to consider when it comes to implementing group work (Cartwright & Zander, 1968). Structural properties include the group size and activities as well as the group members' content background, time commitment, and roles in the group. All these aspects influence how successful a group is and what students learn from each other. Furthermore, Forsyth proposed in his research that there are strong connections between group dynamics, learning, and changes in personal development (2014).

Guided by Forsyth's conceptual framework on group dynamics, we evaluated how small- and large-group work in the cadaveric laboratory affects students in their learning approach, experience, and personal development. Using a case study analysis methodology and thematic analysis, we compared group work at Colorado State University (CSU) and Rocky Vista University (RVU). This study adds to the literature focusing on group learning to support curricular instruction and incorporating effective methods of teaching.

RELEVANT LITERATURE

Working with cadavers is an expensive undertaking due to the high cost of transportation, preservation, and storage. As a result, most cadaver-based anatomy classes assign students into groups working closely on one cadaver without help from faculty and staff. Some institutions focus on self-directed group learning whereas others underline the presence of teaching assistants in the laboratory. The benefits of collaborative learning have been well documented in a variety of disciplines (Gokhale, 1995; Green et al., 2016; Michael, 2006; Zimbardo et al., 2003) including anatomy curricula (Dunkin & Hook, 1978; Durán et al., 2012; Hall et al., 2013; Huitt et al., 2015; Kamei et al., 2012; Vasan et al., 2011). Some of the reported benefits include active learning (Michael, 2006), efficiency in terms of faculty to student ratios (Durán et al., 2012), students taking responsibility for their own learning (Vasan et al., 2011), and improved student outcomes (Vasan et al., 2011). Further, group work and peer teaching with cadavers provides the students with the opportunities to develop hands-on, communication, and leadership skills (Pawlina et al., 2006).

An example of small group work in the cadaveric laboratory was used in a study by Nwachukwu et al. (2014), who used weekly assessments to evaluate the dissection quality of small groups. This study investigated the perception of these weekly assessments and suggested that the evaluation of dissection helped the group to use their time effectively in the laboratory and helped them better learn anatomy. Holland and Pawlikowska (2019) implemented anatomical, case-based learning in the anatomy classroom to facilitate small group learning and evaluated student perceptions. However, major results concentrated on discussions while working on these cases rather than overall group dynamics. According to a meta-analysis of STEM courses and programs, Springer et al. (1991) found that small group learning settings are "effective in promoting greater academic achievement" and "more favorable attitudes toward learning" (p.21). They recommended further implementation of small-group work in undergraduate courses. According to Nieder et al. (2005), a study on team-based learning in a medical gross anatomy course found similar results, although the study primarily focused on student performances and predicting examination scores to identify at-risk students. Small group sessions throughout the course included objective-oriented assignments, an individual test, a group test, and a group application problem. Faculty noted improvements in problem solving skills and students' preparedness for the course when

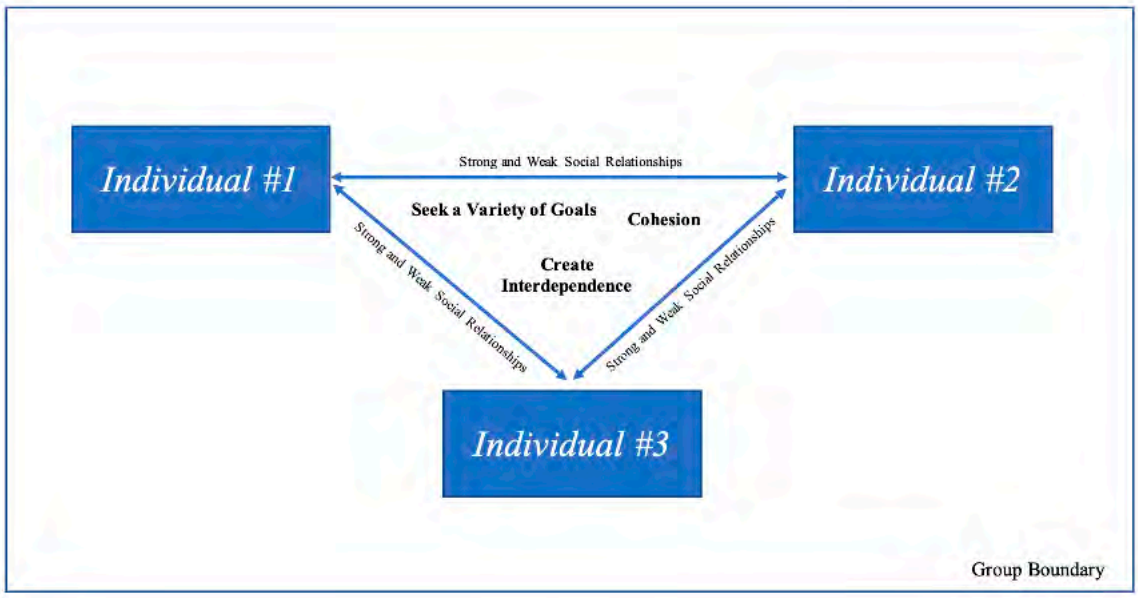
exposed to group work. Constant feedback from peers as well as faculty and staff can give each student the opportunity to develop higher reasoning skills (Nieder et al., 2005). In Vasan et al. (2011), test scores improved when medical students were exposed to group work in their anatomy course. The students perceived team-based learning as a motivator to be a responsible team member and to contribute to collective learning by the team. Further, it reinforced self-directed learning and fostered an appreciation for peer respect, both of which characterize adult motivation to learn (Wlodkowski & Ginsberg, 2017). According to Johnson and Johnson (1987), students who acquire interpersonal and small-group skills have greater learning, better critical thinking, and more retention.

Through the lens of the social sciences, Forsyth (2014) focused on the nature of groups and group dynamics. He defined and described different types of groups, the significance of groups, general group dynamics, and the study of groups. The types of groups include (a) small, unified primary groups, (b) social groups such as work groups and clubs, (c) large collectives, and (d) groups that share a social category (Forsyth, 2014). Forsyth proposed that intergroup relationships increase when the number of group members increases, and he further stated that weak and strong relationships are important for each group to function. Group members follow their individual goals but also pursue goals together and can influence each other and society. Additionally, he stated that studies of groups and their dynamics, such as dealing with group structure, performance, and diversity, provide solutions to practical problems (Forsyth, 2014). Topics in the study of group dynamics focus on "group formation, cohesion, group development, structure, influence, power, performance, conflict, and groups in specific settings" (p. 32). Figure 1 demonstrates a summary of Forsyth's basic structure of groups and shows that no two groups are identical but, by definition, two or more individuals are connected by strong and weak relations, seek a variety of goals, create interdependence and cohesion, and are confined by a group boundary.

To conclude, even though many benefits of group work in the scientific classroom have been reported, the existing literature lacks an analysis of group dynamics and the effects of different group sizes in the cadaveric classroom. Differences in group sizes might affect their time in dissection and their learning experience, study habits, and overall perception on learning human anatomy. This study offers a critical lens for restructuring existing curricula.

METHODS

This study is composed of transcripts of 20 interviews conducted in a human dissection



Note. This is a self-designed conceptual model of group dynamics based on Forsyth (2014) that explains the connections between three individuals forming a group.

Figure 1. Conceptual Model of Group Dynamics

course at CSU and RVU. A qualitative case study methodology and thematic analysis were used to evaluate the group settings. A case study analysis approach was deemed most appropriate for this study as it was used to answer how and why questions to describe a phenomenon within its real-life context (Baxtor & Jack, 2008). This study focused on a descriptive and exploratory analysis of multiple students working in a specific group setting at CSU and RVU as it was important to consider the context within which it occurred (Baxtor & Jack, 2008; PressAcademia, 2009). Ethical approval was granted for the study through the Institutional Review Board at CSU (19-9405H).

At CSU in Fort Collins, CO, faculty and staff integrated group work into the curriculum of a graduate level human anatomy dissection course with the hope of transforming human anatomy instruction in the laboratory into a more active learning and self-directed environment. Students in groups of four were required to complete a full cadaver dissection over one semester. This approach was coupled with group tests with the intent to enhance learning and the overall understanding of human anatomy. Faculty and staff at RVU in Parker, CO, have a similar approach in which groups of 12 students enrolled in the Physician Assistant (PA) program or Master of Science in Biomedical Sciences (MS) program completed a full cadaver dissection.

This case study analysis compared these two laboratory settings and explored the benefits and implications of different sized dissection groups. The following research questions guided the study:

1. What are the group dynamics in a cadaveric laboratory setting?
2. How do group dynamics in a cadaveric laboratory influence the students' personal development as a group member?
3. How does a 4:1 and 12:1 student-to-cadaver ratio impact students' experience and preference in terms of learning human anatomy?

We applied Forsyth's conceptual framework to the group work in the cadaveric laboratories of both universities (Forsyth, 2014; Forsyth et al., 2002). According to Forsyth, group dynamics are the influential interpersonal processes that occur in the individual group and between groups over time. Here, we focused on the dynamics within an individual group. Forsyth's conceptual framework helped define relevant variables for this study and how they might relate to each other. The explanatory variables were structural properties of the group such as group size and how they were formed, time spent in the laboratory, leadership roles, and group activities. The response variables were overall group dynamics, experience within the course, and change in personal development. Based on this framework, we investigated whether a smaller student-to-cadaver ratio would increase cohesion and success and thus more positive group dynamics and change in personal development.

Participants

All students registered at CSU and RVU were eligible to participate in the study and the ones who expressed interest in giving an interview formed an opportunity sample (n = 20; Table 1). They were recruited via an oral script and volunteered their time to participate in the study. Overall, the interviewees were chosen from different groups based on maximum variation sampling, which "selects cases that cut across some range or variation" (Glesne, 2010, p. 51). In detail, the focus for the selection at CSU was on choosing male and female students as well as undergraduate and graduate students in order to increase the variety of backgrounds and opinions about the group work. The age range of the participants was between 20 and 35 years old and most students at CSU were enrolled in a graduate or undergraduate level program in either Biomedical Sciences, Biology, or Health and Exercise Sciences. At RVU, although the groups had a mixture of students from different programs, only the PA students were interviewed. Lastly, none of the students at CSU had experience with taking any dissection coursework before enrollment, but a few at RVU had taken a dissection course before. One participant at RVU completed the dissection course at CSU prior to attending RVU and thus was dissecting a cadaver for the second time. There was about an equal number of students who identified as male or female enrolled in the two courses, but more females were interested in being a participant in this study.

Table 1. Demographics of the Participants

	CSU		RVU
Gender	5 males	9 females	6 females
Education Level	7 undergraduate students		6 physician assistant students
	7 graduate students		

Note. Participants were asked if they identified as a female or male and if they were enrolled in an undergraduate, graduate, or physician assistant program.

Course Structure and Procedure

In the fall semesters of 2017 and 2018, around 50–60 students enrolled in the graduate human dissection course at CSU and in groups of four dissected 14 cadavers. Each group was assigned to a specific cadaver and worked daily on designated anatomical regions. The course was organized into four dissection blocks: lower limb; thorax, abdomen, and pelvis; head and neck; and upper limb. Each block was approximately 4 weeks long and composed of weekly quizzes and one laboratory examination that tested students' knowledge. The course met three times a week for three hours each in the presence of professors, instructors, and teaching assistants. The anatomical areas that needed to be dissected varied in size, difficulty, and detail, and each student was required to contribute equally. It was the group's responsibility to coordinate time for dissecting after hours and on the weekend.

At RVU in the fall semester of 2019, around 70 students enrolled in the professional human dissection course dissecting six cadavers in groups of 12. All students were working on their assigned cadaver for two hours every other week with the presence of professors and postdoctoral fellows. The course was similarly organized in dissection blocks in which each student group had to dissect a few weeks long on the lower limb; thorax, abdomen, and pelvis; head and neck; and upper limb. Each block was composed of weekly quizzes and one laboratory examination that tested the students' knowledge. One difference is that students were not required to dissect outside of general class time as most dissections were completed during class.

Student-to-Cadaver Ratios

Student cadaver groups at CSU were assigned with a ratio of 4:1 meaning that four students received one cadaver to work on. These group assignments were made by the students themselves and did not follow any rules or patterns. Each group received a cadaver for the semester to work on that resulted in a total of around 14 groups of four students.

Student cadaver groups at RVU were assigned with a ratio of 12:1 meaning that 12 students received one cadaver to work on. However, they were further divided into groups of three to dissect in timed blocks for two hours every other week. These group assignments were made by the instructors and based on prior dissection experience. This division resulted in six groups of 12 members each or 24 groups of three members.

Data Collection

The data collection was driven by Forsyth's conceptual framework on group dynamics and focused on the structural properties of student groups including group size, roles such as power dynamics/leadership, and student interactions and how group members influence each other (Forsyth, 2014). All these aspects were applied to the learning environments at CSU and RVU in order to support the theoretical understanding of groups. For this study, 14 interviews at CSU and six interviews at RVU were conducted. In fall of 2017 and 2018, we conducted seven interviews each year at CSU that took place towards the second half of the semester. These interviews were dispersed throughout multiple weeks. At RVU, we conducted six interviews on one day, which took place during the last week of their dissection course.

In general, the entire data collection took place while the primary researcher was a participant-observer in the cadaveric classrooms. Since notetaking or audio recording was prohibited in the classroom, the primary researcher dissected with the students for at least an hour to build rapport and observe and evaluate what program each student was enrolled in at RVU. Interview questions were then asked in a private setting after the dissection.

The following interview questions were used to explore the group dynamics in the cadaveric laboratory (first research question):

- Within your group, do you or your members identify yourselves with a specific role? The answer choices given were leader, active member, teacher, work bee, motivator, quiet observer, and slacker.

- How would you in general describe the dynamics in your group?
- Do you study together or do something fun outside of class together?

Furthermore, the following questions were asked to explore how the group work influenced their personal development as a group member (second research question):

- Have you learned something about yourself throughout this group work?
- Would you say your experience will influence future group work?

In addition, the following interview questions were posed to explore student-to-cadaver ratios and student learning in the content of human anatomy (third research question):

- Do you like your group size, or would you change it?
- What if the student-to-cadaver ratio was bigger or smaller?

Lastly, additional questions were asked to start or end the interview and to explore further structural properties:

- How did you form your group?

Data Analysis

Data from this study were largely analyzed through the lens of a case study as we compared students' experiences of group work within two contexts and built a descriptive, multidimensional framework for later analysis. With that, the interviewees' answers from CSU and RVU were transcribed, analyzed, and compared. The transcription process focused on major informative points stated by the interviewees. No voice pauses or colloquial terms were analyzed since the linguistic aspects did not contribute to the overall goal of this study. We read transcripts and compared them to our notes, and we also coded data and constructed categories and themes. Once similarities and differences between the interviewees were identified, we compared answers and grouped them together while using an open coding scheme. These preliminary results were then reviewed during the phase of axial coding as repetitions of codes were searched and connected (Blair, 2015). Finally, those merged codes assisted in answering the research questions, and we edited the quotations supporting the data for grammatical errors.

Positionality and Trustworthiness

To enhance the quality and trustworthiness of the data, the data collection was member-checked after producing a transcription of each individual interviewee. The positionality of the primary researcher added to the trustworthiness in a way that she was a teaching aid in the dissection courses at CSU and had been working as a Graduate Teaching Assistant for multiple years. She also worked with the students at RVU in their dissection laboratory prior to conducting the interviews. She has an extensive background in human anatomy and cadaveric dissection that might have contributed to the formation of rapport and trust with the students. Since she was exposed to the group work herself years prior, she was familiar with the students' perspectives throughout the study. This similar experience may have negatively influenced the trustworthiness of the study as such work may be seen as a possibility for bias in the themes and choice of interviewees during the study.

FINDINGS

The findings from this study were based on an analysis of the categories and themes that arose during the 20 interviews. Below are brief descriptions of the main themes that are supported by citations from a few participants who preferred to stay anonymous. The structural properties of the groups are determined first and then each research question is answered.

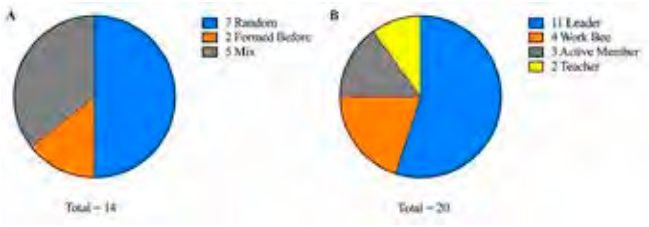
Structural Properties of Groups

At CSU, group members self-selected into groups at orientation day prior to the start of the course. The results indicated that half the students (seven out of 14) did not know anyone prior to the course (Theme: "Random"). Two students had already determined their group members beforehand (Theme: "Formed Before"). The remaining five students said that they had met at least one person before taking this course and thus had a mixture of random and planned group members (Theme: "Mix"). Students at CSU were allowed to form mixed groups of undergraduate and graduate students (Figure 2A).

At RVU, students were not allowed to self-

select their group members as faculty made group assignments prior to the start of the course based on the students' dissection experience (Theme: "Random"). Each group had at least one member of the PA program and one member of the MS program. Since the students shared other courses as well, some students already knew each other at the start of the dissection.

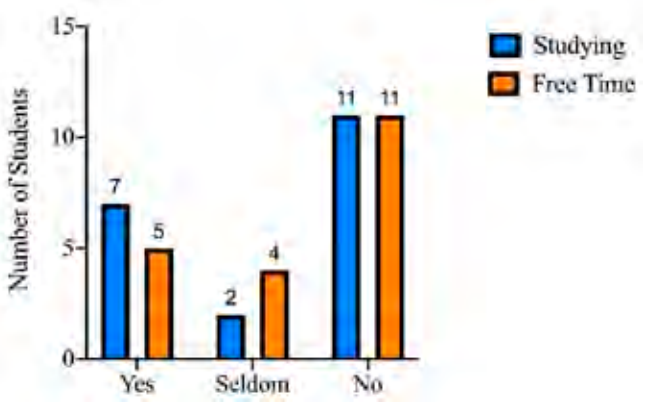
Students at both schools were then asked to state their self-identified group role from a given list. The results indicated that 11 out of 20 students put themselves into a leadership role and had either continued that position throughout the course or had stepped back a little bit in certain dissections. A leader by definition is a person who organizes a group and makes the majority of decisions. Some stated that they naturally fall into leadership positions when it comes to group work as they tended to coordinate and schedule tasks. Being a work bee was the second most popular role chosen by the students, followed by three active members and two teachers (Figure 2B). A work bee was described as being in the laboratory and dissecting often. An active member was open to being told what to do and completing the assigned task. Students who took on the role of "teacher" were those who enjoyed quizzing the other group members or shared their knowledge while in the classroom. Motivator, quiet observer, and slacker were not selected.



Note. A. Students at CSU indicated if they randomly formed or were put into a group, had formed their group before the course started, or if it was a mixture of both. B. Students at CSU and RVU had to state their role within their respective groups from a given list.

Figure 2. Formation of Group at CSU and Identified Role Within Group at CSU and RVU

In terms of group activities at both schools, 11 participants noted that they neither studied with the other group members outside of class nor spent their free time together in doing something outside of school (Figure 3). We noted observed themes based on whether the students did spend time together outside of class, seldom spent time together outside of class, or did not spend time together outside of class. Some students tried to arrange meetings, but their different course schedules and private lives made it hard for those who were interested in meeting together. One participant stated, "it might help group dynamics if [the group] spent more time [together] outside of dissection." However, most of these 11 participants shared that they had regular meetings with members outside their group to get to know better the other class members or to have some time away from their group. One participant who was not content with his group explained he was "going to look out for [himself] and [his] grade" as he felt that the others were not putting in the same effort as he was and thus he preferred not to study with them. He also stated that this course was an honor for him and that he had "kind of gravitated more towards the groups that [were] strong studiers, that [were] serious about this, that [were] here for the right reasons" when it came to spending their free time together. Others had seen each other outside of dissection on rare occasions and had mentioned that they studied together before examinations or quizzes to review the content of human anatomy. Less than 40% of the students stated that they had set study hours together and frequently did something outside of academia. They indicated that they had become friends and that they also helped each other out outside of dissection in other courses or in their private lives. The sharing of learning strategies across the interviewees were not mentioned nor reported as valued and important.



Note. While some students participated in group activities, the majority reported spending no time in group activities during studying or free time.

Figure 3. Group Activities

Research Question 1: What are the group dynamics in a cadaveric laboratory setting?

The overall group dynamics differed among the participants and two themes emerged with those students who were being "satisfied" with the group" and those who were "unsatisfied." At RVU, the PA interviewees appreciated the mixture of students as every member was able to contribute to the dissection differently due to their educational background and the other courses they were enrolled in. In their groups of three, they talked about school, learned from each other, and helped each other out in their private life. Only one participant stated that it was uncomfortable at times as members tended to work quietly for the two hours of the dissection. Occasionally, they chatted about academic topics, but since they did not see each other often, they preferred to just stay focused on the dissection. In respect to their groups of 12, little to no communication was present among the interviewees as they saw each other only during the overlap of their assigned dissection times. One student reported that she did not feel that she was part of a group as the times were split and no one would dissect outside of general class time. Sometimes she would ask the other groups a few questions when she studied for exams, but overall, everyone was pretty satisfied with their group and their dissection work.

At CSU, interviewees extensively elaborated on how the dynamics had changed to positive throughout the semester. Similar to RVU, the mixed groups of graduate and undergraduate students reported that it was nice having group members with different backgrounds. Many students from both universities mentioned that it was hard figuring out each person's strengths, communicating with each other, and making schedules to dissect outside of general class time. One undergraduate participant who had a stronger background in human anatomy than her other group members mentioned that it took some time for her to feel like they were a cohesive team, as stated in the following excerpt:

> *At the beginning, all three of my group members […] were scared they would disappoint me […]. Now it feels like […] we are all working together towards the goal. I think a lot of it also comes with trust […], them trusting themselves to be able to know things and do things.*

As the semester progressed, the CSU interviewees stated that the experience had been positive, conflict free, cohesive, and productive once initial power struggles were eliminated. Some students even became friends with their group members and tried to enroll in future courses together. One participant stated that the many hours per week dissecting a cadaver motivated him to engage with his group and work on issues that arose. Nevertheless, three participants were not very satisfied with their group. One participant was frustrated that there was no system in place to hold individuals accountable for equal work and proper dissection. He reported that the number of hours he dedicated to dissecting negatively affected his time to study outside of class. None of these negative experiences were reported by the participants from RVU.

Research Question 2: How do group dynamics in a cadaveric laboratory influence the students' personal development as a group member?

The students were directly asked if they experienced a change in personal development to answer this research question. Among all 20 interviewees, 85% reported they had a change in personal development. All the participants implied they had mentally grown throughout the course and learned something about themselves. They reported that these experiences would be beneficial for future professional group settings.

At RVU, one participant mentioned that she generally enjoyed group work but had never been super proactive. She tended to defer to others but said that she had been more hands-on with this dissection project and had taken on tasks more than she had in the past, as seen in the following excerpt:

> *Being in this smaller group [of three] made me realize that I can and I should jump and put myself out there [...]. I find myself just jumping in and doing things more often than I would just because I can.*

She emphasized that all these experiences will influence and affect future group work assignments. One other participant from RVU mentioned learning how to step back at times and another that their enthusiasm for group work had increased. The remaining students stated that it was a unique group setting but it did not change their prior outlook. The student who completed CSU's dissection course

prior to attending RVU revealed that she had to change her expectations drastically throughout the semester as the curriculum at RVU differed so much from what she was used to at CSU. She learned how to express her expectations to her group members and how to adjust them more effectively.

Most participants at CSU mentioned that they changed a lot in their personal development. Many expressed in their interviews that they saw an increase in their communication and conflict resolution skills and in their ability to trust people. Additionally, they reported learning how to express their expectations in a workplace as dissecting a cadaver was seen as a project close to what they may experience in a future health profession. This is demonstrated by the following excerpt:

> *Not everybody is the same […] but that is okay […]. And it is good to kind of struggle with this because there are always going to be group settings no matter where you go […]. It is okay to fail sometimes […].*

Similar to RVU, one CSU participant mentioned that he learned to step back and take a follower role instead of being a leader, as seen in the following excerpt:

> *When I was in Nebraska [for military], we were always put in a leadership role […]. Having this class […] you really need to know when to take a step back and just be told what to do because if everybody tried how to delegate things, then no work is ever going to get done […]. I am a lot more comfortable [now] in a follower role.*

Additionally, participants at CSU reported a change to their studying and learning approach. They believe they learned how to study smarter and go beyond what they thought they could handle in terms of workload, as seen in the following excerpt:

> *I know for sure that the way I have approached learning has changed […]. In the past, […] I [would] just memorize [information] and not think about how it relates to each other […]. But then here with this [course], I really learned to take these things […] and just look at them as systems […] and not so much to memorize everything and make connections.*

Research Question 3: How does a 4:1 and 12:1 student-to-cadaver ratio impact students' experience and preference in terms of learning human anatomy?

When asked if the participants enjoyed the number of people in their group, four per group at CSU compared to 12 per group at RVU, all CSU participants indicated that they preferred the small student-to-cadaver ratio as it provided them the opportunity to be a part of every dissection (Theme: "Small S:C Ratio"). They mentioned that the workload was attainable but that it could get crowded during small areas of dissections, such as the head and neck, when really only one or two students were able to dissect at the same time. The interviewees referred back multiple times to how the extensive group work contributed to the development of useful group skills. When prompted about what it may be like working with a bigger group, all 14 CSU interviewees agreed that the learning opportunities and experience would decrease. They feared missing out on dissections and other workload challenges that drove extensive communication skills to produce a cohesive group.

Similarly, RVU students noted that the groups of three were beneficial as two could dissect at the same time while the other studied. One participant mentioned that "three ha[d] been good because [they got] to do more […] and learn more at the same time." Comparing that with the group of 12, two participants stated that studying had been harder because they only got to dissect every other week and missed out on some of the dissected areas, as demonstrated in the following: "I feel like there is a lot missed when people are dissecting different [areas] that we don't get to dissect […]. That knowledge does not really come together for me until I am preparing for the practical [examination]." The participant who took the dissection course at CSU prior to attending RVU was able to compare both curricula and student-to-cadaver ratios. She was excited that she got to dissect again at RVU after graduating from CSU, but she was sad that the groups were bigger and that she did not get to complete a full cadaver dissection again, as seen in the following excerpt:

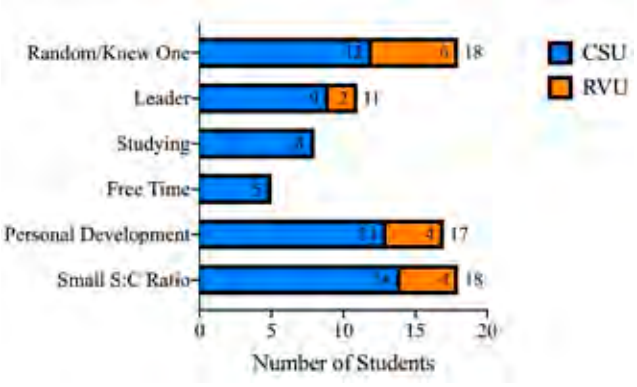
> *That [course at CSU] was one of the most incredible experiences I am ever going to have in my life. Having four people on one*

body from start to finish in one semester […]. You got to take such an active role in every single part of the dissection and you have to know your group members so well […]. [At RVU], I wasn't able to dissect the heart because it was not on my week.

Two participants at RVU were not bothered by the bigger group dissection (Theme: "Large S:C Ratio"). One pointed out the larger group allowed her to focus on other coursework demands. The other student mentioned that the actual dissection did not matter to her as she was glad to have a reduced workload.

DISCUSSION

Guided by Forsyth's conceptual framework on group dynamics, we evaluated how small- and large-group work in the cadaveric laboratory affects students in their learning approach, dissection experience, and personal development. Here, we suggest that small- and large-group work in a science classroom has distinct benefits and implications and offers a critical lens for restructuring curricula and incorporating effective methods. Although the group dynamic results varied slightly between the different locations, overall, the findings were similar (see Figure 4). Students at RVU and CSU were either randomly placed in groups or they knew one classmate when they choose groups. More students in the small groups at CSU took the leadership role compared to RVU. The time spent studying and free time showed mixed results between groups in the two locations. The majority of students at CSU and at



Note. Comparison of all 20 interviewees from CSU and RVU. Random group or knew at least one other student, assigned themselves the role as the group leader, studied with group members outside of general class time, spent free time together as a group, experienced a change in personal development, and preference of student-to-cadaver (S:C) ratio.

Figure 4. Overall Trends at CSU and RVU

RVU indicated that they experienced a change of view and a shift in personal development through the group work in the cadaveric laboratory, and most of the students preferred a smaller student-to-cadaver ratio.

In general, the group settings at CSU and RVU can be defined by Forsyth conceptual model as a mixture of primary and social groups. A primary group is defined as a "small, intimate cluster of close associates" such as peers (Forsyth, 2014, p.11). They are connected by frequent interaction in many face-to-face settings. A social group is larger and often task-oriented, as seen in study groups (Forsyth, 2014) where the purpose is to complete a task instead of forming strong relationships. Based on the time the students spent together in class and the mutual task of dissecting a cadaver, it can be concluded that CSU's group setting is a bit more personal and time intensive when compared to RVU's group setting. This might have influenced the dynamics observed at both schools.

At CSU, the dynamics varied between the groups and corresponded with the number of dissection hours they put in outside of general class time as well as the success in the course itself. The data on group size were inconclusive due to a lack of quantitative data analysis; however, it could be speculated that if a group received good grades, students were more eager to spend time with other group members. Their reported reasoning cited similar engagement and effort as themselves. As one participant stated, he had "gravitated more towards the groups that [he knew were] strong studiers, that [he knew were] serious about this." Spending a lot of time together outside of scheduled hours to dissect cadavers influenced students' personal development. The students reported that they developed study skills and ways to become a responsible group member during this time. This idea of being motivated to become a responsible group member and expressing peer respect is supported by the literature (Vasan et al., 2011). The interviewees also learned how to adapt and communicate expectations to become a higher functioning group. This finding supports Johnson and Johnson (1987) that frequent group work can result in a change in personal views and development. Further, this is also supported by Forsyth's conceptual framework on group

dynamics. He stated that people individually seek their own objectives, but group settings can constrain and guide them (Forsyth, 2014). As seen at CSU, all the participants experienced a change in personal development due to being exposed to large- and small-group settings. The students learned how to approach conflicts and change their study habits based on their group dynamics.

Conversely, it appeared that such group work did not necessarily favor sharing learning strategies or increase social interactions outside of the classroom. Vasan and colleagues (2011) described that when students are exposed to group work, they are more likely to experience self-directed learning and collective learning by the team. Furthermore, based on Forsyth's conceptual framework, we suspected that a smaller student-to-cadaver ratio would cause increased student cohesion and success, and bring about more positive group dynamics with changes in students' personal development. Here, however, only half of the CSU students indicated they studied course material outside of scheduled class time together. Most of that studying was content related and no study strategies were shared, though this may have been due to the smaller groups having a larger volume of work per student. Additionally, these students were navigating a new paradigm with an enormous amount of small group work. Their unwillingness to share strategies may be due to their lack of confidence in this paradigm. It was stated numerous times that learning strategies formed previously in undergraduate studies did not apply in this course. Over the course of the semester, the participants changed their learning approach from rote memorization to forming connections within the presented material. The remaining participants preferred studying alone or with members of other groups because this was their most effective use of time outside of their shared dissection hours, as seen in the following citation: "It's hard [to all get together and study] because we are all on different schedules." To overcome in the future this lack of social interactions and studying outside of class, previously enrolled students may come back and visit the course during the first few weeks to communicate the associated benefits of working together as a group.

In contrast, the group dynamics at RVU were generally positive among the participants throughout the course. Even though the students did get along well, it was mentioned multiple times that they faced a large workload from other courses while being in the dissection course. These students were not required to dissect outside of general class time and spent less time together, which may have contributed to the lack of getting to know the other group members in a more personal manner. Forsyth's description of social groups supports this finding. He proposed that members of social groups are task-oriented and mainly focus on their assignment rather than developing extensive relationships. Surprisingly, we found the larger student-to-cadaver ratio at RVU resulted in an overall more positive group dynamic when compared to CSU. The RVU students reported spending less free time together and less group time studying for dissection; however, most participants mentioned that they worked together in other courses which could have been a result of the positive group dynamics in their dissection course. Based on the RVU interviews, there was little change in personal development reported, which contrasts with the CSU findings. The difference could have been due to the larger group size at RVU. Treen et al. (2016) suggested that student performance increases in line with group size until groups have five members, and in larger groups students may not be able to give the material the attention it deserves and group coordination, collaboration, and teamwork may suffer as groups become bigger. To solve this problem, faculty could schedule laboratory times in which all group members work together to increase group coherence and communication skills. Additionally, RVU participant believed this project was comparable to past group work experiences whereas a CSU student described the dissection course as the "ultimate group project." It appears that the more time invested in dissecting the cadaver, the more reflection and changes in personal development were reported.

Juxtaposing their preference of group work versus individual work with the overall group dynamics and free time spent with their group members, no conclusive results were observed at either school, which suggests that their prior preferences had only minimal effect on their experience.

LIMITATIONS AND FUTURE RESEARCH

There are a few limitations to this research to consider. Both institutions involved in this study use clinical examples to demonstrate anatomical importance; however, the CSU faculty have a more academic focus while RVU faculty have a more clinical focus. For example, the weekly quizzes conducted by CSU faculty graded both the quality of the dissection and the anatomical knowledge of the group, whereas the weekly quizzes at RVU were graded on the students' knowledge of clinically relevant anatomy and did not focus on dissection quality. This was stated by a participant who had completed CSU's dissection course before attending RVU. This likely influenced the quality of the dissections for the participants at both institutions and ultimately may have had an effect on how much time they spent dissecting during and outside of general class time. One participant stated that CSU's dissection course was "the hardest thing [she had] done." The time-consuming group dissections found at CSU (around 30–40 hours per week) that had the goal of being high-quality dissections may have put increased pressure on the group. Students at RVU commented that they would have not been able to keep up with the dissection course and their other courses if the dissections hours per week were longer.

Additionally, RVU's group members were predetermined by randomly assigning students to a group. This demonstrates a limitation as it is hard to evaluate how the CSU students' choice of group members had an impact on the overall results. Future studies focusing only on predetermined groups would enhance the data and be an interesting juxtaposition to these results.

Another limitation is the difference in the number of participants at CSU compared to RVU. At CSU, the primary researcher was able to conduct this study over multiple semesters. The CSU interviews were more spaced out over time, which might have contributed to the establishment of an increased rapport and trust with the students. At RVU, only one visit was scheduled, and all interviews had to take place on that day, which may have influenced the quality of the interviews performed. Detailed demographic aspects as well as in-depth background research of the participants could be considered in the future to enhance the power of this study. Further, it would be beneficial to interview all members of the same group to examine the values, beliefs, and thoughts of the participants, and focus group interviews could be conducted in addition to individual interviews. Finally, dissection groups with a higher student-to-cadaver ratio could be implemented in the same classroom to further compare the similarities and differences between individual group sizes.

CONCLUSION

This study showed that different group sizes influence students' personal development, learning strategies, and overall experience in a cadaveric classroom. This study revealed the importance of considering group sizes in the cadaveric classroom, and educators need to evaluate which group size will generate the desired results for their corresponding curriculum. Most cadaveric classrooms focus on knowledge acquisition as some students might never need their dissection skills in their future careers. However, additional nonacademic skills that are hard to measure should be taken into consideration when setting up a curriculum. For example, working in health care requires constant team building and conflict resolution to provide efficient care for those in need. Nurses, physicians, and professionals of different specialties must work effectively in a team, communicate, and share their resources to solve health problems (Humphreys et al., 2009).

A smaller student-to-cadaver ratio as seen at CSU may support a bigger change in the students' personal development as a group member and their learning strategies and increase their exposure to the learned material. However, small group work in the cadaveric laboratory may require more time for dissection outside of general class time and fewer students being able to enroll in the course. Faculty working with many smaller groups might see an increase in their workload as they try to address each individual student. A bigger student-to-cadaver ratio as seen at RVU may be more beneficial when students face a large workload outside of the dissection course and are not planning on using their dissection skills in the future. This allows more students to enroll in a course. Even though large group work may still result in some change in personal development, the decreased workload may also reduce students' exposure to

the material, which could affect their developed learning strategies and communication skills with their group members. Faculty working with many larger groups might be challenged to address each student individually.

In this study, we suggest that both small- and large-group work in a cadaveric classroom have benefits and implications and offer a critical lens for restructuring curricula and incorporating effective methods. This study provides valuable information that can be applied to medical schools that have integrated cadaveric instruction into their curriculum with the need to better understand the impact of group dynamics on adult learners. Overall, the courses at CSU and RVU were designed to address the enrolled students as adult learners. The adult learner is selective, self-directed, and brings previous knowledge and experience to the classroom. They are often interested in content that has direct application to their lives (Jarvis, 2004; Rubenson, 2011). The curriculum at both schools may have contributed to the observed benefits and implications of small- and large-group work in these courses. These connections to adult learners and curriculum could guide future studies and contribute to the need in how to effectively address the adult learner in STEM classrooms. Besides informing educators in the anatomical sciences, other classrooms using group learning would benefit from this analysis to evaluate which group size would generate the desired results for their corresponding curriculum.

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