



## Original Research

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### The Effects of Virtual Group Study on Class Views and Performance

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#### ABSTRACT

***Educational Practices in Kinesiology 4(1): Article 2, 2024.*** Peer-to-peer teaching improves academic performance. During the worldwide pandemic, peer-to-peer teaching was unavailable, and feelings of isolation and loneliness increased. This study investigated the impact of virtual peer-to-peer group study on student performance and class views in a virtual, undergraduate exercise physiology course. College-aged adults ( $N = 69$ ) were randomly assigned to study with a virtual group or individually for two instructional units. Students switched groups after the first unit. For virtual group study, students met virtually for at least one hour outside of class to study course content. Unit exams were given after each instructional unit. Mann-Whitney tests were used to evaluate study group differences on class performance. Class views were assessed using seven-point Likert scales and Wilcoxon signed-ranked tests. Exam scores were not significantly different between the virtual group study and individual study for exam 1 ( $72.3 \pm 8.6\%$  vs.  $70.4 \pm 13.3\%$ ,  $p = .824$ ) or for exam 2 ( $68.5 \pm 14.5\%$  vs.  $67 \pm 13.5\%$ ,  $p = .782$ ). Virtual group study led to greater class connection ( $2.4 \pm 1.3$  vs  $5.1 \pm 1.6$ ;  $p < .001$ ) and focus ( $2.05 \pm 1.11$  vs  $2.94 \pm 1.23$ ;  $p < .001$ ) than individual study. Virtual group study, outside of class, had a significant effect on in-class connection and outside-of-class study focus without reducing class performance. Virtual group study may be an effective tool to help students connect out of class when other meeting options are not available.

**Keywords:** Virtual Learning, exercise physiology, science education, collaborative work

#### ■ INTRODUCTION

Collaborative learning is an educational approach where groups of learners work together to study, problem solve, complete a project/task, or create a product (Laal & Laal, 2012). The positive benefits of collaborative learning are well documented (Järvelä et al., 2010; Laal & Ghodsi, 2012; Laal & Laal, 2012; Vázquez-García, 2018). For example, collaborative learning helps develop a social support system for learners and establishes a positive atmosphere (Laal & Ghodsi, 2012). Further, collaborative learning helps develop positive attitudes toward educators, increases self-esteem, and reduces anxiety among students (Laal & Ghodsi, 2012). Because students are actively involved in the learning process, collaborative learning promotes critical thinking and results in improved academic performance (Laal &

Ghods, 2012). In fact, student retention of class content also improves due to a collaborative approach to learning (Vázquez-García, 2018). Lastly, collaborative learning has also been shown as a helpful tool in improving student motivation (Järvelä et al., 2010).

A version of collaborative learning is peer-to-peer teaching. In this method, students work together in groups (two or more peers) to teach each other concepts regarding course material (Cortright et al., 2005; Stigmar, 2016). As opposed to reading individually or sitting passively while listening to a lecture, students who teach each other important class concepts may develop a deeper understanding of course material (Bargh et al., 1980). Participation in this educational practice not only helps students become responsible for their own learning, but they also become responsible for the learning of their classmates (Rathner & Byrne, 2014). Previous research indicates college students improve academic performance in physiology courses after using group study or peer-to-peer teaching (Bian et al., 2018; Giuliadori et al., 2006; Mohammad et al., 2021; Rao & DiCarlo, 2000; Relling & Giuliadori, 2015). For example, in a human physiology class, students engaged in a team-based learning approach improved an exam grade by 27% (score without peer instruction =  $44 \pm 5\%$ , score with peer instruction =  $59 \pm 6\%$ ) (Cortright et al., 2005). Similarly, undergraduate students in a gross anatomy class who used a form of peer-to-peer instruction had a final grade nearly 40% higher than students who did not use this method (score without peer instruction =  $50.1 \pm 20.4\%$ , score with peer instruction =  $69.5 \pm 16\%$ ; (Viana et al., 2019). Collectively, these studies indicate that peer instruction enhances mastery of course material and ability to solve novel problems (Cortright et al., 2005). For these reasons, learning using a study group, where peers can discuss concepts and teach each other key principles, has been a popular method of study in college.

During the coronavirus disease (COVID-19) pandemic, educational administrators, with the guidance of local government and public health officers, directed institutions to reduce class sizes or stop providing face-to-face instruction. Many faculty members shifted teaching modalities to a synchronous virtual classroom, using streaming technologies such as Zoom™, where educators were able to provide course content during the normal scheduled class time. Although many classes resumed virtually, the self-isolation from the COVID-19 pandemic influenced the emotional well-being of students (Kaparounaki et al., 2020; Kim et al., 2022; Labrague et al., 2021; Wang & Zhao, 2020a). For example, adults attending college in China reported higher stress and anxiety during the pandemic than those not attending college (Wang & Zhao, 2020b). Similarly, college students in Greece reported increased depression and suicidality during the pandemic when compared to pre-pandemic norms (Kaparounaki et al., 2020). Depression, alcohol use, and eating disorders in first- and second-year college students across the United States significantly increased during the pandemic (Kim et al., 2022). Lastly, Labrague and colleagues, reported that out of 261 surveyed college students, nearly 57% reported being moderately lonely and nearly 24% reported being severely lonely during the lockdowns due to COVID-19 (Labrague et al., 2021). Collectively, these studies support the idea that students felt increasingly disconnected from each other while still attending virtual classes. Thus, there is a need to find ways for students to feel more connected and less isolated when taking virtual classes. One possible way to do this is through having students meet with one another virtually outside of a classroom setting. However, this has not currently been investigated.

Besides the impact that virtual classes may have on the well-being and connectedness of students, it may have an impact on their ability to learn. With regards to the study of exercise physiology, little research has been done investigating how virtual classes impact academic performance (McFarlin, 2008). The educational research in the field of exercise physiology has varied and included topics such as the use of

concept maps and hybrid lecture formats to improve performance (Henige, 2012), the impact of different majors on performance in an exercise physiology course (Bulger et al., 2007), and common misconceptions that occur in exercise physiology course content (Morton et al., 2008). Researchers have also focused on improving attitudes and perceptions, cognitive development, and ethical practices of exercise physiology labs by using high-inquiry level activities, inquiry-based learning, and interactive videos (Henige, 2011; Kolkhorst et al., 2001; Senchina, 2011). However, studies directed toward using virtual, out-of-class collaborative learning or peer-to-peer teaching are nonexistent. Additionally, to our knowledge, no study has investigated how group learning influences overall views and feeling of class connection in an exercise physiology class. Therefore, the purpose of our project was to explore undergraduate student performance and class views using different modes of studying in a virtual exercise physiology course. We hypothesized that using collaborative peer-to-peer virtual study groups would improve both overall academic performance and students' views of the class.

## ■ METHODS

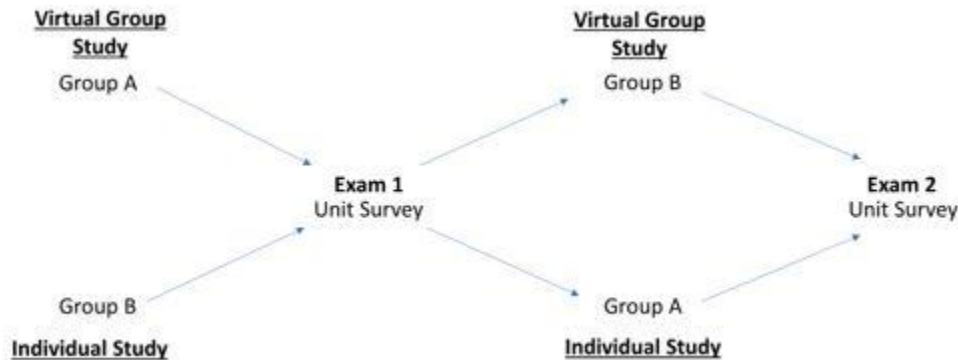
### *Participants*

Undergraduate students ( $N = 69$ ; 35 female and 34 male) enrolled in two sections of a 300-level exercise physiology course participated in this study during the first semester of 2021. The average GPA was  $3.3 \pm 0.5$ . Each course was taught by a different instructor and the instructors covered the same content each week. The course is the first of two exercise physiology courses in the major. Students must complete general anatomy and physiology courses prior to enrollment in this course so in-depth learning of metabolism, fuel utilization, muscle function, respiration, neurophysiology, and how each of these concepts apply to exercise and movement is possible. On the first day of class, students were provided detailed information (verbally and written in the syllabus) about the study. A description of the group learning scheme and how performance data would be used for analysis were provided. Each student had the opportunity not to participate. If students had chosen not to participate, course requirements would have been modified (i.e., not participating in this study would not influence final grades). All students enrolled in the courses participated in the study. This study followed ethical standards of the Helsinki Declaration and was approved by the university's ethical review board (IRB #: F20-026).

### *Procedures*

Following a cross-over study design (every student completed each condition), students were randomly assigned to one of two study methods: 1) virtual group study, consisting of 5 students per group or 2) individual study. For the first instructional unit (~four weeks of the class), half of the students were assigned to the virtual study group and half were assigned to individual study. For the second instructional unit (~four weeks of class), students switched study methods; those previously assigned to the virtual group study method were placed in individual study and those who were previously in individual study were assigned a virtual study group (see Figure 1). Virtual study groups were created by the instructor based on the student's cumulative grade point average entering the class. First, the instructor ranked students based on grade point average. Next, the number of groups was determined based on the number of students within the class (e.g., 6 groups were created to allow 5 students in each group with 30 students total). Then, the instructor started at the top of the ranked list and added students to each group (e.g., the first student entered group 1, the second student entered group 2, etc.). Once a student was entered into all groups, the order reversed (e.g., the seventh student entered group 6, the

eighth student entered group 5, etc.). This process continued until all students were assigned to a group. This group assignment process was done to diversify performance ability within each group.



**Figure 1.** Outline of study protocol. Each group spent one instructional unit (~four weeks) in each study group.

For virtual group study, instructions were provided for the students to connect with their group members, outside of scheduled class time, using an electronic virtual platform of their choice (e.g., Zoom™) for a minimum of 60 minutes per week. Students were given suggestions on how to use that study time effectively, such as working on an exam study guide together, reviewing notes and studying unclear course content, and teaching each other concepts. The same instructions and suggestions on how to study for each group were provided to each class. Students did not meet virtually, outside of class to complete any other group assignments. To control peer support, students assigned to the individual study group were instructed to limit time connecting and communicating about course content with peers outside of the scheduled class. At the end of each week, students were given a survey to report the number of hours studied individually or with the virtual study group. At the end of each instructional unit, another survey, using 7-point Likert scales, was given to report on student views of the class and study method. The 7-point Likert scale included the following descriptions: 1-Strongly agree, 2-Agree, 3-Somewhat agree, 4-Neither agree nor disagree, 5-Somewhat disagree, 6-Disagree and 7-Strongly disagree. A list of the survey questions can be found in Table 1. At the end of each instructional unit, all students, independent of study method, took the same 50-question multiple choice exam (each teacher used the same exam). Due to ethical concerns about asking students to study using a method that may not be their preferred study method, the lowest exam score was dropped in final grade calculations.

### *Statistical Analysis*

The independent variable was mode of studying (peer-to-peer virtual group or individual), and the dependent variables were class performance (measured using unit exam scores) and student views (measured using 7-point Likert survey). Mann-Whitney tests were used to evaluate how the mode of study influenced class performance. Wilcoxon signed-rank tests were used to evaluate how mode of study influenced class views. Effect sizes were calculated using a Rank-Biserial Correlation (small = 0.1, medium = 0.3, large = 0.5). All statistical tests were performed using JASP software (Version 0.16.2; JASP Team, 2022). Significance was set at an alpha level of 0.05. Values are represented as means and standard deviations.

**Table 1:** Survey Questions Given to Students at the end of each Instructional Unit

<b>Statement Number</b>	<b>Individual Study</b>	<b>Virtual Group Study</b>
1	Individual study increased my confidence on content knowledge prior to taking the unit exam.	Virtual group study increased my confidence on content knowledge prior to taking the unit exam.
2	Individual study increased my ability to synthesize and integrate material.	Virtual group study increased my ability to synthesize and integrate material.
3	Individual study increased my overall learning of the course material.	Virtual group study increased my overall learning of the course material.
4	Individual study increased my desire to learn the material.	Virtual group study increased my desire to learn the material.
5	I felt more connected and focused during virtual class because of my out-of-class individual study.	I felt more connected and focused during virtual class because of my out-of-class virtual group study.
6	My time spent in individual study was effective.	My time spent in virtual group study was effective.
7	I enjoyed individual study.	I enjoyed virtual group study.
8	My perception of remote learning increased by doing individual study.	My perception of remote learning increased by doing virtual group study.
9	I felt more connected to other students in class because of individual study.	I felt more connected to other students in class because of virtual group study.
10	During individual study, my level of focus was high.	During virtual group study, my level of focus was high.
11	During individual study, I wished I could get peer feedback on what I knew and what I didn't know.	During virtual group study, I wished I could get peer feedback on what I knew and what I didn't know.

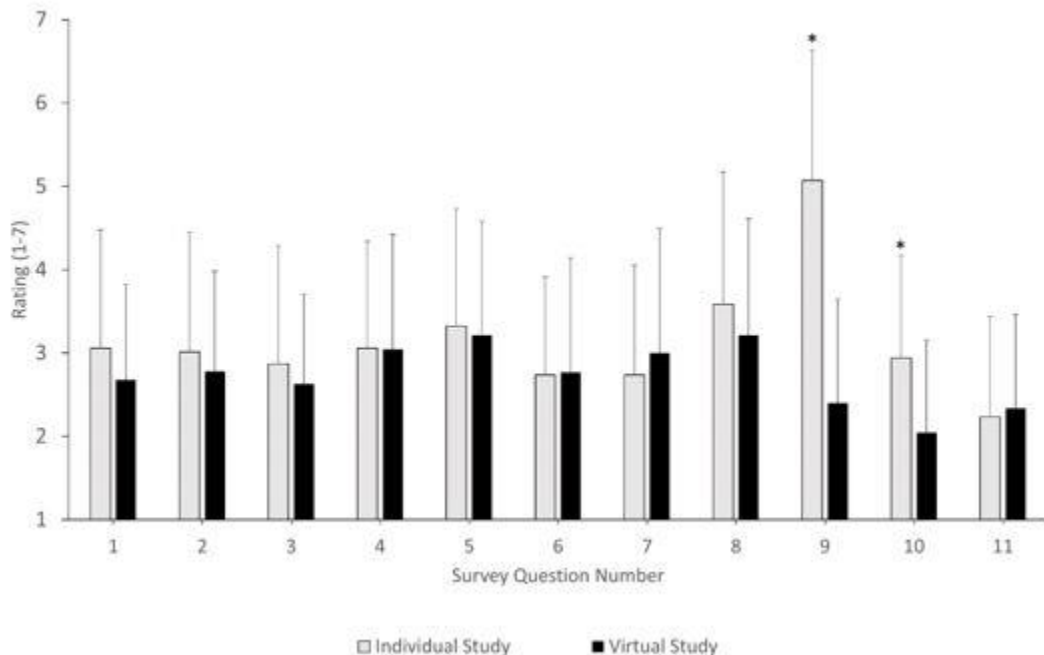
## RESULTS

### Exam Scores

Exam scores were not significantly different between virtual group study and individual study for exam 1 ( $72.3 \pm 8.6\%$  vs.  $70.4 \pm 13.3\%$ ,  $p = .824$ ) or for exam 2 ( $68.5 \pm 14.5\%$  vs.  $67 \pm 13.5\%$ ,  $p = .782$ ). When students were assigned to individual study,  $44.3 \pm 11.5\%$  reported studying for three hours or less per week and  $55.7 \pm 11.5\%$  reported studying more than three hours per week. When students were assigned to virtual group study,  $25.1 \pm 8.4\%$  of students reported spending less than an hour per week studying together while  $74.9 \pm 8.4\%$  of students reported spending an hour or more per week studying in their group. In the virtual groups,  $51.7 \pm 12.5\%$  of students also reported studying individually for three hours or less per week while  $48.3 \pm 12.5\%$  reported studying individually for more than three hours per week.

### Class Views

The results for the survey can be found in Figure 2. Compared to individual study, the virtual group study had significantly higher overall class connection meaning students who participated in virtual group study felt more connected to other students in class (individual study =  $5.1 \pm 1.6$ , virtual group study =  $2.4 \pm 1.3$ ,  $p < .001$ ). The Rank-Biserial effect size for this comparison was high at .92 (95% confidence interval = .86 – .95). Students also felt that virtual group study increased their focus during study time more than individual study (individual study =  $2.94 \pm 1.23$ , virtual group =  $2.05 \pm 1.11$ ,  $p < .001$ ). The Rank-Biserial effect size for this comparison was high at .67 (95% confidence interval = .45 – .81).



**Figure 2.** Average Likert question scores for individual and virtual study groups. Question numbers are on the x-axis and questions can be found in Table 1. \*  $p < .05$  from the virtual study group.



## ■ DISCUSSION

We hypothesized that virtual group study, outside of class, would improve academic performance and students' attitudes and views of a virtual class. The results partially supported the hypotheses. First, virtual group study did not produce significant differences in exam performance, which did not support the hypothesis. Second, virtual group study did significantly improve the focus of students during their study time and increased their feelings of connectedness with virtual classmates, which supported the hypotheses.

Surprisingly, it was not found that virtual group study improved academic performance over individual study. In the field of physiology, there have been many studies indicating that peer-to-peer teaching improves content retention and overall performance in class (Bian et al., 2018; Cortright et al., 2005; Giuliadori et al., 2006; Mohammad et al., 2021; Rao & DiCarlo, 2000; Relling & Giuliadori, 2015; Stigmar, 2016; Wagner & Gansemer-Topf, 2005). This study is unique in that students were asked to engage in group study, using virtual technology, for at least 1 hour a week outside of class. The weekly study reports filled out by each student indicated that 25% of students in virtual group study did not meet the 1 hour of virtual group study required throughout the research period. The reason for the lack of adherence is not known, however, it is plausible that students may have been experiencing some amount of 'Zoom fatigue,' a psychological effect associated with decreased emotion, energy, and motivation, and increased burn-out (Bullock et al., 2022). Students have indicated that the use of video technology for an extended period is an energy-draining experience, both physically and emotionally (Amponsah et al., 2022). With the rapid shift to use virtual technology for hours each day, the motivation to spend more time online, outside of class, could have been low. It seems that even though students were asked to meet outside of class for at least 1 hour per week, many students assigned to the virtual study group chose to place more emphasis on individual study time. It can be conjectured that the time spent studying individually, even for those assigned to virtual group study, influenced exam scores more than the time students spent studying in their virtual groups. This brings into question whether the recommended group study time (1 hour per week for 4 weeks) was sufficient to elicit performance differences. For example, Cortright and colleagues formed study groups that worked together for the entire duration of a course. By the end of the course, those students who used peer-to-peer teaching had better content mastery and increased ability to solve complex problems (Cortright et al., 2005). It is possible that students in our study did not have enough time to get to know their group members and feel comfortable expressing ideas. Thus, a longer duration spent in virtual study (more than 4 weeks) may have been needed to elicit performance benefits. Additionally, students in our study were given freedom to choose how to use group study time. Suggestions on what to study were given and exam study guides were provided, but students chose the study content and method. Therefore, it is unclear if the way they studied in their groups may have influenced the results of the study. Although exam performance was not different between groups, the broad recommendation to study and limited time spent together could be reasons virtual group study added no performance benefit.

When compared to individual study, our results suggest that students felt more focused while studying with other students, even if studying happened virtually. Although not measured in our study, one possible explanation for this result could be that distraction may decrease during group study. Sources of distraction while studying can include instant messaging, social media, internet browsing, and entertainment streaming. Distractions while studying are prevalent as college students experience an average of 35 different distractions during an independent 3-hour study session (Calderwood et al., 2014). Additionally, Rosen and colleagues (2013) found that students lasted six minutes on a task before

getting distracted by technology, such as text messaging or Facebook. Further, students who have high Facebook usage are more distracted during academic tasks (Feng et al., 2019). It seems logical that when students use collaborative study groups, the need for connection, through social media apps, decreases. Students can help each other stay on task while studying and distractions decrease. The social aspect of group study may be a benefit of limiting distractions and increasing study focus.

An important finding of this study is that students felt more connected to their peers during virtual class after participating in collaborative learning groups that connected virtually. During the COVID-19 pandemic, feelings of isolation and loneliness were heightened. These feelings were especially prevalent in college students. It has been reported that close to 81% of college students felt moderate or severe loneliness throughout the pandemic (Labrague et al., 2021). Even though classes continued as virtual synchronous or asynchronous delivery, class connection waned. Current results indicate that educators can increase cohesiveness and feelings of unity in the classroom by simply requiring weekly, out-of-class virtual study groups. These results should be taken cautiously, however. Students assigned to individual study were instructed to self-study alone and not connect with others in class (see Table 1, Statement 9). Undoubtedly, the more students can interact with each other, the more comfortable and unified they feel in class. Thus, the use of group teaching is a superior method of study because of increased interaction between classmates (Stigmar, 2016). As the mental well-being of students continues to be an important area of focus for educators in the classroom, it is valuable to know that those with mental health issues benefit (e.g., greater connection, better feeling of group belonging, able to share how to cope with day-to-day challenges) from face-to-face interaction with their peers using virtual technology (Naslund et al., 2016). For these reasons, using virtual study groups does not have to be limited to a virtual teaching medium. In-person classes may also see increased class connection and cohesiveness by asking students to meet virtually outside of class. Future studies should investigate if connectedness could be increased through virtual group work outside of inside class time.

This study has limitations. First, data were collected during only one semester of an undergraduate exercise physiology course. Consequently, the number of students involved was small. Second, data were collected from students taking class from two different educators. Although (1) directions for each group were the same, (2) exam questions for both sections were identical, and (3) content delivery happened using the same medium (Zoom™), class views could have been different due to how the teachers conducted the classes. This is one reason why a within-subject study design was utilized. This permitted main comparisons between study methods and not between class sections. Third, even though students were in various locations throughout the United States due to the virtual nature of the class, this study only included students enrolled at the same institution (i.e., this study did not use multiple institutions to broaden the input from college students at different universities). Lastly, as mentioned above, although students were asked to spend at least one hour a week in virtual group study, a quarter of the students did not achieve the suggested amount of time. With these limitations in mind, the results of this study can only be inferred toward this specific sample.

In conclusion, this study supports the use of out-of-class virtual group study. The use of these study groups enhanced overall class connection during class, improved focus while studying course content, and had no negative effect on overall class performance. These benefits were seen with only a small amount of out-of-class commitment (no more than 1 hour per week). As online education continues to trend upward, future research should consider other mental health and academic performance benefits that virtual collaborative learning and peer-to-peer teaching can offer.



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