INFORMATION SYSTEMS EDUCATION JOURNAL

Volume 18, No. 5
October 2020
ISSN: 1545-679X

In this issue:

iscap
Information Systems & Computing Academic Professionals

The **Information Systems Education Journal** (ISEDJ) is a double-blind peer-reviewed academic journal published by **ISCAP** (Information Systems and Computing Academic Professionals). Publishing frequency is six times per year. The first year of publication was 2003.

ISEDJ is published online (http://isedj.org). Our sister publication, the Proceedings of EDSIGCON (http://www.edsigcon.org) features all papers, panels, workshops, and presentations from the conference.

The journal acceptance review process involves a minimum of three double-blind peer reviews, where both the reviewer is not aware of the identities of the authors and the authors are not aware of the identities of the reviewers. The initial reviews happen before the EDSIGCON conference. At that point papers are divided into award papers (top 15%), other journal papers (top 30%), unsettled papers, and non-journal papers. The unsettled papers are subjected to a second round of blind peer review to establish whether they will be accepted to the journal or not. Those papers that are deemed of sufficient quality are accepted for publication in the ISEDJ journal. Currently the target acceptance rate for the journal is under 40%.

Information Systems Education Journal is pleased to be listed in the Cabell's Directory of Publishing Opportunities in Educational Technology and Library Science, in both the electronic and printed editions. Questions should be addressed to the editor at editor@isedj.org or the publisher at publisher@isedj.org. Special thanks to members of EDSIG who perform the editorial and review processes for ISEDJ.

INFORMATION SYSTEMS EDUCATION JOURNAL

Students' Perceptions of Challenges and Solutions to Face-to-Face and Online Group Work

Nesrin Bakir
nbakir@ilstu.edu
Illinois State University
Normal, IL 61761

Sean Humpherys
shumpherys@wtamu.edu

Kareem Dana
kdana@wtamu.edu

Computer Information and Decision Management
West Texas A&M University
Canyon, TX 79016

Abstract

Effective collaboration in small teams is valued by employers. Group projects can be a valuable experience in academics to apply knowledge, solve problems, and develop teamwork skills. Students frequently encounter group work in academic classes but are often not taught how to facilitate effective group collaboration and left to "figure it out on their own." Students frequently complain of group work because of bad past experiences. This research reports on two studies. In Study 1, business students (n=120) in a Management Information Systems course worked on a multi-week group project (4-5 students) and reported the challenges they experienced. Study 1 identified the types of problems students self-reported in group work and examined whether face-to-face and online students experienced the same problems. A survey and qualitative analysis were used. Result showed that students identified lack of communication, participation, collaboration, accountability, and interaction as the most common problems experienced. Study 2 (n = 129) attempted to ameliorate the problems by requiring the use of the communication software Slack and to improve accountability by using Google Docs to track responsibilities. The majority of students reported benefits from these tools. The list of the most common problems experienced is differed from study 1, indicating that the tools might have had a positive impact. The results showed that the proportion of students reporting problems in communication, participation, accountability, and interaction reduced significantly for face-to-face students with these tools but did not reduce for online students.

Keywords: group work, online learning, collaboration, small group communication

1. INTRODUCTION

Students learn best when they are actively involved in their learning process (Davis, 1993). In both face-to-face and online learning environments, instructors implement a variety of learning strategies to create meaningful learning experiences. One common instructional strategy used is group work. Group work is the collaboration of students working on the same

learning goals. Implemented correctly, group work has been found to foster learning (Favor & Kulp, 2015; Kemp & Grieve, 2014; Lowes, 2014), help students apply knowledge (Elgort, Smith, & Toland, 2008), encourage problem-solving skills (Canham, Wiley, & Mayer, 2012; Shimazoe & Aldrich, 2010), acquire greater communication skills (Oakley, Felder, Brent, & Elhajj, 2004), and develop teamwork skills among students (Brutus & Donia, 2010). Group work has been used in both face-to-face and online courses (Bonk, Lee, Liu, & Su, 2007; Ekblaw, 2016). However, implementing group work successfully, especially in online classes, continues to be a major challenge for instructors and students.

The purpose of this study was to examine students' experiences regarding group work in both face-to-face and online courses. Specifically, this research investigated group work in a Management Information Systems course. The results of this study may help instructors design group work that can increase student learning, success, and satisfaction.

The study addressed the following research questions:

1. What are the challenges that undergraduate students experience with group work in education?
2. Are there any differences in undergraduate students' perceptions of or challenges with group work when comparing face-to-face and online course delivery?
3. What ameliorations might have the potential to overcome the challenges undergraduate students face in group work?

2. LITERATURE REVIEW

Several studies found that online students dislike group work much more than face-to-face students (Favor & Kulp, 2015; Kemp & Grieve, 2014; Lowes, 2014). One study concluded that in adult learners, the attitude towards online group work influenced by prior negative experiences is unlikely to change regardless of how effective the current instructor or group is (Favor & Harvey, 2016). Roberts and McInnerney (2007) and Ekblaw (2016) summarized seven major challenges that impacted group work in both face-to-face and online environments. These challenges included:

- Student apathy towards group work. Students are not motivated or do not understand the benefits of group work.
- Selecting an appropriate process and the size of the group.
- Lack of group or social skills. Students often do not have the collaboration, management, or leadership skills needed to be an effective member of a group.
- Free riders are group members who do not participate yet receive the same grade.
- Inequality of student abilities within the group.
- Poor distribution or delegation of roles and responsibilities within the group.
- The fair or inequitable assessment of individuals within the groups.

Many of these challenges are interrelated. For example, student apathy can lead to free riding. Lack of group skills can lead to poor distribution of roles (Roberts & McInnerney, 2007). Additionally, Riebe, Girardi, and Whitsed (2016) noted that educators favored teaching content over process and tended to place students in teams with little or no instruction on how to work in teams. This was a major challenge to group work.

While most literature generally agrees on problems that can occur during group work, the solutions often diverge. Roberts and McInnerney (2007) attempted to provide a solution to each of the seven problems. However, some of the solutions may not be feasible such as creating an entirely new course focused on teaching group work skills. Ekblaw (2016) made a distinction between cooperation and collaboration. He defined cooperation as delegating tasks in parallel so that team members can work independently. Furthermore, he defined collaboration as the process of working on the tasks synchronously and collocated, which can be difficult to implement online. Ekblaw suggested that collaboration was more important to a successful group. Lowes (2014) researched online groups and found that delegating tasks in parallel was more effective than synchronous collaboration of group members.

Students are often most concerned about and motivated by their grade. Fairly assessing group projects has a large impact on students' perceptions of the success or failure of the project (Favor & Harvey, 2016; Roberts & McInnerney, 2007). Baugh (2017) attempted to solve the problem of assessing group projects by

tracking student contributions. Students would log their specific work in a database. Then, the instructor assigned grades based 50% on the final group deliverable and 50% on the contribution of the individual student. Baugh (2017) concluded that students liked tracking their contributions and preferred the visible level of accountability afforded by a database. Other researchers highlighted the use of peer evaluations for assessment (Favor & Harvey, 2016; Oakley et al., 2004).

Javadi, Gebauer, and Novotny (2017) used network analysis to compare face-to-face and online groups who used a discussion forum for learning. Their research concluded that online discussions closely resembled face-to-face interactions. Kemp and Grieve (2014) compared face-to-face and online communication in groups that were collaboratively writing. Their study indicated that online students registered more complaints regarding communication and indicated a preference to communicating face-to-face. However, the study also noted that there was no significant difference in academic performance face-to-face and online students, even though the online students complained more.

This research is built on prior research by investigating group work as defined by the following characteristics: small group sizes (4-5 members), collaboration over several weeks, and producing a written business document. This definition can be generalized to a business context where professional teams collaborate to produce a deliverable such as proposals, recommendations, business decisions, etc.

3. METHODOLOGY

Participants

Two studies were conducted. In both studies, the participants were undergraduate students at a regional university in the southern United States. They were enrolled in a junior-senior level, required Management of Information System course in a college of business with a typical undergraduate age range of approximately 20-30 years old with a few outliers. For Study 1, the survey was sent to 189 students. One hundred twenty students (face-to-face = 52, online = 68) completed the survey. Participants included 72 females (60%) and 48 males (40%). Participant's major included management (22%), general business (21%), finance (17%), accounting (16%), marketing (11%), computer information systems (9%), economics (3%), and business law and ethics (2%). For Study 2, the survey was sent to 152 students. One hundred twenty-nine students (face-to-face = 67, online = 62) completed the survey. Participants included 61 females (47%) and 68 males (53%). Participant's major included management (21%), finance (19%), marketing (17%), computer information systems (13%), general business (11%), accounting (9%), economics (4%), entrepreneurship (4%), and international business (2%).

Context

As part of the Management of Information System course curriculum, students completed a group project where they acted as an information systems consultant for a fictitious company. The goal of this assignment was for students to experience the analysis and design phases of the software development life cycle process (SDLC) and recommend a solution that involved an off-the-shelf, information system solution. The SDLC simulation was created by the professors who taught the course. The company had problems associated with growth: more employees than previously experienced, accounting inefficiency, over 90-day aging, errors in manual paper timesheet and payroll processes, desire to expand into new locations, desire to use social media marketing, interoperability problems, etc. The stakeholders, who were actors playing the role of owner, accountant, marketing director, and general manager, answered the following questions in a video. The video format was chosen to simulate a face-to-face meeting with stakeholders.

1. What do you do?
2. Please describe the problems you are facing and the associated business processes.
3. What are the negative impacts of these problems? What are the pains caused by these problems and can you quantify the negative impact?
4. How do you see the process changing if you could have anything you wish?
5. What requirements will your solution need to have? What constraints are you working under that we need to consider?

These videos were hosted on a website https://www.cis.wtamu.edu/simulation/.
Students were required to select the predefined interview questions as if they, the consultants, asking the question. The related video would play of the stakeholder answering the question. Students used stakeholder responses to identify problems in business processes, quantify the

impacts of those problems, identify system requirements, identify any system or business constraints, and propose an IS solution. Students wrote this content into a 10-14 page proposal.

The group project lasted four weeks within a 16-week curriculum and included four phases. In Phase 1, students created their group profiles, communication plan, conducted the analysis phase, and identified the two business problems they wanted to solve. In Phase 2, students identified a potential information system solution and wrote about the IS in detail. In Phase 3, the professor met with each group to give feedback on the draft proposal. In Phase 4, students finalized the proposal, turned in the proposal, and completed peer evaluations. Three instructors taught the course. They all followed the same written course materials for the group project.

Data Sources

The data for both studies came from an online survey that was administered at the end of the group project. The survey for Study 1 consisted of demographic questions such as class standing and major and a question, "Check all the problems you encountered while working with your group this semester." Participants could select from sixteen predefined answers. Some of these were adapted from Koh and Hill (2009). The participants could also select "Other" as a response and free form an answer. Participants were also asked to answer an open-ended question, "Think about your overall current group experience in this class. What challenges did you encounter working with your group? Please explain." Participants reflected on the challenges they faced and wrote their response in short-answer form. The survey for Study 2 was the same as Study 1 with additional of question regarding students' perceptions of Slack and Google Docs. The "lack of communication" question was reworded to "communication problems among group members" to improve understanding.

Participants in Study 2 followed the same protocol as in Study 1, except that they were required to use a professional communication tool and a simple task management tool. Slack is a free, professional collaboration and communication tool (slack.com). Slack allows for file sharing and a log of conversation. This log enables the instructor to evaluate communication quality. Instructors can use the log generated by Slack to see which students are participating and which are not. Slack is available for mobile or web platforms. Students were also required to use a Google Doc to track who is responsible for which tasks modeled after Lean Six Sigma's Kaizen newspaper. This functionality can reduce miscommunication regarding who does what tasks and may add a level of personal accountability. The expectation was that with these tools the problems experienced by students in Study 2 will be lessened or different than in Study 1.

Data Analysis

Descriptive statistics were used to summarize the data. For the open-ended question, the authors coded the data as follows. First, the authors independently read the open-ended responses. The data were reviewed and analyzed using the constant comparative method (Glaser & Strauss, 1967). The authors then identified themes and categories related to students' experiences with the group project (Lincoln & Guba, 1985). Then, the authors compared, discussed, and agreed on the emerging themes until they all reached an agreement. A two-proportion, z-test was conducted in R to test if students experienced fewer challenges in Study 2 than in Study 1.

4. RESULTS

Results for Study 1 are as follows. In both face-to-face and online sections, lack of communication among group members was rated as the most frequent problem participants experienced (37% of face-to-face respondents reported having experienced a lack of communication, 32% among online students). Table A1 identifies all the problems students expressed (see Appendix A).

Other reported problems experienced by the face-to-face students were as follows: lack of participation from group members (35% of students expressed this concern), lack of collaboration among group members (33%), lack of accountability of group members (33%), and lack of interaction among group members (31%).

In the online sections, students reported other problems such as difficulty understanding the goal of the project (28%), lack of interaction among group members (26%), lack of participation from group members (25%), and lack of initiative from group members (25%). The open-ended question analysis supported the main finding that lack of communication was the most frequent problem experienced. We concluded that the face-to-face and online

students largely experienced the same top challenges.

Results for Study 2 are as follows. Study 2 had students use Slack as a communication tool and Google Doc to track tasks and assignments. Online students and face-to-face students had different opinion regarding these tools. Regarding Slack's impact on group communication, face-to-face students rated "fair" or "poor" at 55% (n = 67). Online students rated Slack's impact on group communication as "very good" or "excellent" at 63% and "good" at 23% (n = 62). To the question "How did using Google docs to track tasks and due dates impact your group collaboration", face-to-face students reported "very good" or "excellent" at 73% and "good" at 18%. Online students reported "very good" or "excellent" at 56% and "good" at 24%. As the top five challenges experienced by students in Study 2, face-to-face students ranked the following: lack of my own time management (21% report experiencing this problem), communication problems among group members (16%), difficulty understanding the goal of the project (16%), lack of motivation (15%), and lack of participation from group members (13%). Online students' top five challenges differed: lack of participation from group members (48%), lack of my own time management (32%), communication problems among group members (29%), and lack of collaboration among group members (24%). Appendix B reports all the problems experienced by students in Study 2.

Using Slack and Google Docs as tools was predicted to lower the proportion of students experiencing top challenges that they reported in Study 1, specifically communication, participation, accountability, and interaction. These constructs were selected to study because they were rated as the top five challenges observed in Study 1, were common to both online and face-to-face students, and the communication tools in Study 2 were designed to solve these specific problems. To test for significant differences between the two studies, a two-proportion z-test was conducted to compare the proportion of students in Study 2 who experienced communication, participation, accountability, and interaction problems to those of Study 1. If the communication tools had a positive effect in Study 2, a reduction in proportion should be observed compared to Study 1 (See Table 1 and Table 2).
Table 1 presents the results of a two-proportion z-test comparing the proportion of face-to-face students who reported experiencing certain challenges. Proportions were significantly different in Study 2 than in Study 1, indicating that fewer students in Study 2 experienced communication, participation, accountability, and interaction challenges than in Study 1. We attribute this to the use of Slack and Google Docs in Study 2. The statistics are as follows: communication (X-squared = 5.3, df = 1, p-value = 0.01), participation (X-squared = 6.3, df = 1, p-value = 0.006), accountability (X-squared = 9.1, df = 1, p-value = 0.001), and interaction (X-squared = 5.3, df = 1, p-value = 0.01). See Appendix C for reproducible R code and data.

Table 1. Proportion of face-to-face students' challenges

Problem Experienced	% of Students in Study 1	% of Students in Study 2
Communication	37%	16%*
Participation	35%	13%***
Accountability	33%	9%***
Interaction	31%	12%**
Sample size	52	67

Note. The data is the proportion of students saying they experienced a particular problem. Test of significant differences comparing Study 1 to Study 2 is * p <= 0.05, ** p <= 0.01, *** p <= 0.001.
Table 2 reports the a two-proportion comparison for online students in Study 1 and Study 2. While a reduction in proportion is observed for some constructs, none of the constructs were significantly different.
Table 2. Proportion of online students' challenges

Problem Experienced	% of Students in Study 1	% of Students in Study 2
Communication	32%	29%
Participation	25%	48%
Accountability	24%	23%
interaction	26%	23%
Sample size	68	62

Note. No significant differences.

5. DISCUSSION AND LESSONS LEARNED

The purpose of Study 1 was to identify student perspectives, particularly challenges, they encountered with group work. The purpose of Study 2 was to try a treatment that could alleviate the problems experienced by students in group work. The type of group work included 4-5 person groups where students identified two

business problems, recommended business solutions to those problems using information systems, and wrote a business proposal.

The main finding of Study 1 was that students considered lack of communication with their group members to be their largest hindrance. There was no difference between face-to-face and online students. When students complained of lack of communication, they meant not having enough communication with group members, not having enough interactions, initiating communication at the last minute, conducting low quality discussions, experiencing lack or poor generation and evaluation of ideas, and having conflicts with their peers with no resolutions. Students chose texting as their technology for communication, and some students referred to texting as a poor tool for communication.

In some instances, the lack of participation by some group members led to a lack of communication in terms of quantity and quality. Lack of participation is distinguished from lack of initiative as follows: Initiative is defined as taking action independently without being assigned. Participation is being involved in the process regardless of whether the task was assigned by someone else or not. Conflicting schedules was another hindrance students experienced. Some students shared that they were busy with work and family. This impacted the availability and frequency of their communication. Findings also revealed that students experienced more problems during the first phase of the project than in subsequent weeks.

Study 2 attempted to ameliorate the problems experienced by students by requiring the use of Slack to communicate and Google Docs to track responsibilities. The vast majority of online and face-to-face students reported improvements in communication and to group collaboration because of Slack and Google Docs.

Students' report of the most common problems experienced were different than from Study 1. We interpret this observation as the tools having a positive impact such that the problems in Study 1 were reduced in Study 2 and new problems were exposed in Study 2. We observed the proportion of students reporting problems in communication, participation, accountability, and interaction reduced significantly for face-to-face students using the communication tools but not for online students. Online students, who may need the communication tools more than face-to-face students, did not seem to experience as great an effect even though their perceptions were that the tools were beneficial.

In Study 2, students ranked "lack of time management by myself" and "lack of time management group members" among their top challenges. This observation may mean that the communication tools had positive impacts on some challenges and exposed new weaknesses that future studies can help address.

Changes to future course offerings

Instructors may form group projects with the assumption that students know how to work in groups and do not teach group collaboration (Gueldenzoph Snyder, 2009; Riebe et al., 2016). As a post-reflective activity, we searched the literature for additional solutions to group collaboration challenges. Oakley, Felder, Brent, and Elhajj (2004) recommended using learning activities early in the semester to introduce group work skills before the group project. The three instructors did a similar activity where each group completed an activity on Slack. The purpose of this learning activity was to introduce students to each other and familiarize them with how to use Slack. Research also showed that practice exercises at the beginning of the course could foster group work and communication skills (Ekblaw, 2016; Roberts & McInnerney, 2007). Gueldenzoph Snyder (2009) reviewed business communication literature to identify team building exercises which could be adapted to academic learning.

Ekblaw recommended instructors assign functionary roles to each team member rather than letting teams figure out what needs to be done by whom. In online classes, Lowes (2014) recommended structuring the group project so that students could work on their parts asynchronously and independently. Students still cooperated but would depend less on synchronous collaboration.

Scarfino and Roever (2009) suggested a card game called Diversity as the activity which can help build communication skills. Gueldenzoph Snyder (2009) outlined a group learning activity as follows. In small groups, ask the students to discuss the pros and cons of group work. Ask students to discuss the purpose of the class project. Ask students to role-play positive collaboration, e.g., active listening, questioning, and restating techniques. Ask students to develop a timeline by reverse engineering a project. Train students to negotiate conflicts by asking students to role-play impartial methods

to resolve any problem. This activity can be done with online students via team collaboration software or discussion forums.

6. CONCLUSION

Group projects can be a valuable experience in academics to apply knowledge, solve problems, and develop teamwork skills. These skills are requested by employers. The instructors of this course opine that a subset of College of Business students have not learned how to effectively communicate in groups despite having taken two semesters of English classes and experiencing other group projects in other classes. Many students are not prepared for communicating or collaborating in real-world teams. Students identify lack of communication, participation, collaboration, accountability, and interaction as the most common problems experienced in group work.

We demonstrate that using professional communication tools can have positive impacts on collaboration. As educators, we have a responsibility and opportunity to help students overcome inter-group communication challenges. Doing so will give students a valuable skill to take into the workforce.

7. REFERENCES

Baugh, J. M. (2017). Assessment of Group Projects. *Proceedings of the EDSIG Conference on Information Systems and Computing Education*, v.3 n.4355, Austin, Texas.

Bonk, C. J., Lee, S.H., Liu, X., & Su, B. (2007). Awareness design in online collaborative learning: A pedagogical perspective. *Advances in Computer-Supported Learning*, 251–273. https://doi.org/10.4018/978-1-59904-355-5.ch011

Brutus, S., & Donia, M. B. L. (2010). Improving the effective-ness of students in groups with a centralized peer evaluation system. *Academy of Management Learning & Education*, *9*(4), 652–662. https://doi.org/10.5465/amle.9.4.zqr652

Canham, M. S., Wiley, J., & Mayer, R. E. (2012). When diversity in training improves dyadic problem solving. *Applied Cognitive Psychology*, *26*(3), 421–430. https://doi.org/10.1002/acp.1844

Davis, B. G. (1993). *Tools for Teaching*. San Francisco: California: Jossey-Bass Inc.

Ekblaw, R. (2016). Effective use of group projects in online learning. *Contemporary Issues in Education Research*, *9*(3), 121–128.

Elgort, I., Smith, A. G., & Toland, J. (2008). Is wiki an effective platform for group course work? *Australasian Journal of Educational Technology*, *24*(2), 195–210. https://doi.org/10.14742/ajet.1222

Favor, J. K., & Harvey, M. (2016). We shall not be moved: Adult learners' intransigent attitudes about group projects. *Adult Education Research Conference*. Retrieved from http://newprairiepress.org/aerc/2016/papers/18

Favor, J. K., & Kulp, A. M. (2015). Academic learning teams in accelerated adult programs: Online and on-campus adult students' perceptions. *Adult Learning*, *20*, 1–9. https://doi.org/10.1177/1045159515596928

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory*. Chicago: Aldine Publishing Company.

Gueldenzoph Snyder, L. (2009). Teaching teams about teamwork: Preparation, practice, and performance review. *Business Communication Quarterly*, *72*(1), 74–79. https://doi.org/10.1177/1080569908330372

Herrmann, N. (1995). *Whole Brain Model*.

Javadi, E., Gebauer, J., & Novotny, N. (2017). Comparing Student Interaction in Asynchronous Online Discussions and in Face-to-Face Settings. *Information Systems Education Journal*, *15*(3), 64–71.

Kemp, N., & Grieve, R. (2014). Face-to-face or face-to-screen? Undergraduates' opinions and test performance in classroom vs. online learning. *Frontiers in Psychology*, *5*(1278), 1–11. https://doi.org/10.3389/fpsyg.2014.01278

Koh, M. H., & Hill, J. R. (2009). Student perceptions of groupwork in an online course: Benefits and challenges. *Journal of Distance Education*, *23*(2), 69–92.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Inquiry*. Beverly Hills: Sage Publications.

Lowes, S. (2014). How Much "Group" is there in Online Group Work? *Journal of Asynchronous Learning Networks*, *18*(1).

Oakley, B., Felder, R. M., Brent, R., & Elhajj, I. (2004). Turning student groups into effective teams. *Journal of Student Centered Learning*, *2*(1), 9–34.

Riebe, L., Girardi, A., & Whitsed, C. (2016). A systematic literature review of teamwork pedagogy in higher education. *Small Group Research*, *47*(6), 619–664. https://doi.org/10.1177%2F1046496416665221

Roberts, T. S., & McInnerney, J. M. (2007). Seven problems of online group learning (and their solutions). *Educational Technology & Society*, *10*(4), 257–268.

Scarfino, D., & Roever, C. (2009). Team-Building Success: It's in the Cards. *Business Communication Quarterly*, *72*(1), 90–95. https://doi.org/10.1177/1080569908330375

Shimazoe, J., & Aldrich, H. (2010). Group work can be gratifying: Understanding and overcoming resistance to cooperative learning. *College Teaching*, *58*(1), 52–7.

Appendix A. Students' Problems from Study 1

Summarized data from the survey responses by students after experiencing the group project. The survey asked, "Check all the problems you encountered while working with your group this semester." Students could select from sixteen predefined answers that were adapted from Koh and Hill (2009). The students could also select "Other" as a response and free form an answer (see Table A1).

Table A1: Problems Students Encountered in Group Work

Challenge Description	% of Face-To-Face Students Expressing this Challenge (N = 52)	% of Online Students Expressing this Challenge (N = 68)
Lack of communication among group members	37%	32%
Lack of participation from group members	35%	25%
Lack of collaboration among group members	33%	22%
Lack of accountability of group members	33%	24%
Lack of interaction among group members	31%	26%
Lack of time management (group members)	29%	21%
Lack of understanding among group members	27%	24%
Lack of initiative from group members	27%	25%
Lack of time management (myself)	23%	16%
Difficulty understanding the goal of the project	21%	28%
Lack of feedback from group members	21%	16%
Lack of encouragement from group members	19%	15%
No problems encountered	15%	24%
Lack of a sense of community	13%	16%
Lack of feedback from instructor	10%	1%
Lack of group dynamics	8%	9%
Lack of leadership	6%	7%
Late to meeting	2%	N/A
Lack of motivation	2%	N/A
Confused about the project	2%	N/A
Difficult peer	4%	N/A
Different opinions	N/A	1%
Unequal distribution of tasks	N/A	1%
Too much leadership	N/A	1%
Miscommunication	N/A	1%
Communication method	N/A	1%
Problems with technology	N/A	1%

Note. The percentage refers to the number of students out of the total respondents for face-to-face or for online who expressed the complaint.

Participants answered an open-ended question, "Think about your overall current group experience in this class. What challenges did you encounter working with your group? Please explain." Participants reflected on the challenges they encountered and wrote their response in short-answer form. Researchers analyzed the responses into categories of problems (see Table A2 and Table A3).

Table A2: Challenges Encountered by Face-to-face Students According to Open-ended Responses (N = 52)

Challenge Description	% of Students Expressing this Challenge
Lack of Communication (e.g., lack of response or feedback from peers)	22%
Lack of Peer Participation	19%
Different Schedules (e.g., working adults)	13%
Lack of Accountability of Peers	7%
Poor Time Management	6%
Difficult Peer (e.g., peer who took over project, peer did not listen to other group members, difficult to reach agreement or consensus)	4%
Difficult to Meet	4%
Difficult to use consistent writing style/format	3%
Lack of Collaboration	3%
Lack of Understanding of Project	3%
Unequal Task Distribution	3%
Lack of Expectations	3%
Lack of Quality Work from Peer	3%
Group Too Big	1%
Burned out at the end of the semester	1%
Not using Google Docs	1%
Overall Organization of Project	1%

Note. A qualitative analysis of the open-ended question resulted in these themes

Table A3: Challenges Encountered by Online Students According to Open-ended Responses (N = 68)

Challenge Description	% of Students Expressing this Challenge
Lack of Communication (e.g., lack of response or feedback from peers)	34%
Different Schedules (e.g., different time zones)	24%
Lack of Peer Participation	18%
Lack of Accountability of Peers	9%
Time Management (Poor)	7%
Difficult to use consistent writing style/format	4%
Difficult Peer (e.g., peer who took over project, not being open to criticism, difficulty to reach agreement)	3%
Lack of Collaboration	3%
Figuring out how to delegate tasks	3%
Not Knowing Peers	3%
Lack of Motivation (Peer)	3%
Online Aspect	3%
Lack of Understanding of Project	1%
Unable to Meet In person	1%
Group Too Small	1%
Adapting to Peer Personalities	1%
Hard to Depend on Others	1%
Different Work Styles	1%
Having a Group Project in an Online Class	1%

Note. A qualitative analysis of the open-ended question resulted in these themes

Appendix B. Students' Problems from Study 2

Summarized data from the survey responses by students after experiencing the group project in study 2. Regarding Table B1, students explicitly selected predefined choices in the survey. The survey asked, "Check all the problems you encountered while working with your group this semester." Regarding Table B2 and Table B3, students answered open-ended questions about problems they experienced and the problems were categorized by the researchers.

Table B1: Problems Students Encountered in Group Work from Study 2

Challenge Description	% of Face-To-Face Students Expressing this Challenge (N = 67)	% of Online Students Expressing this Challenge (N = 62)
No problems encountered	24%	48%
Lack of time management (myself)	21%	32%
Communication Problems among group members	16%	29%
Difficulty understanding the goal of the project	16%	29%
Lack of motivation	15%	24%
Lack of participation from group members	13%	23%
Lack of collaboration among group members	13%	23%
Lack of time management (group members)	12%	21%
Lack of interaction among group members	12%	21%
Lack of understanding among group members	12%	18%
Lack of accountability of group members	9%	15%
Lack of initiative from group members	7%	15%
Lack of feedback from group members	6%	13%
Lack of a sense of community	6%	11%
Lack of leadership	6%	11%
Lack of encouragement from group members	3%	6%
Lack of feedback from instructor	3%	6%
Lack of group dynamics	1%	3%
Problems with technology	1%	2%
Maybe too long of time to complete 3 weeks would work easy	1%	2%

Note. The percentage refers to the number of students out of the total respondents for face-to-face or for online who expressed the complaint.

Table B2: Challenges Encountered by Face-to-face Students According to Open-ended Responses

Challenge Description	% of Face-To-Face Students Expressing this Challenge (N = 67)
No Problems	30%
Different Schedules (e.g., working adults)	9%
Lack of Communication (e.g., lack of response or feedback from peers)	7%
Lack of Peer Participation	4%
Poor Time Management	4%
Difficult to Meet	4%
Unequal Task Distribution	3%

Overall Organization of Project	3%
Different Work Styles	3%
Lack of Motivation	3%
Difficult Peer (e.g., peer who took over project, peer did not listen to other group members, difficult to reach agreement or consensus)	1%
Difficult to use consistent writing style/format	1%
Lack of Collaboration	1%
Lack of Understanding of Project	1%
Lack of Expectations	1%
Lack of Feedback from group members	1%
Different Work Styles	1%
Too Much Writing	1%

Note. A qualitative analysis of the open-ended question resulted in these themes

Table B3: Challenges Encountered by Online Students According to Open-ended Responses

Challenge Description	% of Online Students Expressing this Challenge (N = 62)
Different Schedules (e.g., different time zones)	27%
Lack of Peer Participation	24%
No Problems	18%
Time Management (Poor)	15%
Lack of Communication (e.g., lack of response or feedback from peers)	13%
Difficult Peer (e.g., peer who took over project, not being open to criticism, difficulty to reach agreement)	5%
Lack of Motivation (Peer)	5%
Lack of Accountability of Peers	3%
Figuring out how to delegate tasks	3%
Lack of Understanding of Project	3%
Technology Problem with Slack	3%
Technology Problem with Google Docs	3%
Difficult to use consistent writing style/format	2%
Lack of Collaboration	2%
Online Aspect	2%
Adapting to Peer Personalities	2%
Different Work Styles	2%
Having a Group Project in an Online Class	2%

Note. A qualitative analysis of the open-ended question resulted in these themes

Appendix C. Reproducible R Code and Data

The following is the data and R code for Tables 1 and Table 2 in the manuscript.

```
#data in raw counts. Number of students expressing they experienced these problems
study1f2f_communication = 19
study2f2f_communication = 11
study1online_communication = 22
study2online_communication = 18
study1f2f_participation = 18
study2f2f_participation = 9
study1online_participation = 17
study2online_participation = 30
study1f2f_accountability = 17
study2f2f_accountability = 6
study1online_accountability = 16
study2online_accountability = 14
study1f2f_interaction = 16
study2f2f_interaction = 8
study1online_interaction = 18
study2online_interaction = 14
#sample sizes, count of students surveyed
study1f2f_N = 52
study2f2f_N = 67
study1online_N = 68
study2online_N = 62

## Communication problems
#Hypothesis study 2's f2f proportion is less than study 1's
#results: confirmed significant. p =0.01
prop.test(x = c(study2f2f_communication, study1f2f_communication), n = c(study2f2f_N,
study1f2f_N), alternative = "less")

#Hypothesis study 2's online proportion is less than study 1's
#results: not significant. p =0.057
prop.test(x = c(study2online_communication, study1online_communication), n = c(study2f2f_N,
study1f2f_N), alternative = "less")

## Participation problems
#Hypothesis study 2's f2f proportion is less than study 1's
#results: significant, p = 0.006
prop.test(x = c(study2f2f_participation, study1f2f_participation), n = c(study2f2f_N, study1f2f_N),
alternative = "less")

#Hypothesis study 2's online proportion is less than study 1's
#results: not sig, p = 0.87
prop.test(x = c(study2online_participation, study1online_participation), n = c(study2f2f_N,
study1f2f_N), alternative = "less")

## Accountability problems
#Hypothesis study 2's f2f proportion is less than study 1's
#results: significant. p = 0.001
prop.test(x = c(study2f2f_accountability, study1f2f_accountability), n = c(study2f2f_N, study1f2f_N),
alternative = "less")

#Hypothesis study 2's online proportion is less than study 1's
#results: not sig. p = 0.15
prop.test(x = c(study2online_accountability, study1online_accountability), n = c(study2f2f_N,
study1f2f_N), alternative = "less")
```

```
## Interaction problems
#Hypothesis study 2's f2f proportion is less than study 1's
#results: significant. p = 0.01
prop.test(x = c(study2f2f_interaction, study1f2f_interaction), n = c(study2f2f_N, study1f2f_N),
alternative = "less")

#Hypothesis study 2's online proportion is less than study 1's
#results: not sig. p = 0.71
prop.test(x = c(study2online_interaction, study1online_interaction), n = c(study2f2f_N, study1f2f_N),
alternative = "less")
```