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# Teamwork makes the dream work: group effectiveness in a “Paper Chase” collaborative writing exercise for higher education

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**Introduction:** Collaborative writing produces higher-quality products and promotes other skills, such as problem-solving, that may assist in team science and employment among higher education students. Opportunities for supportive, cooperative learning and writing may be limited for students. The Paper Chase program is a structured exercise for rapidly disseminating research findings through facilitated, collaborative writing. To support skill development in collaborative writing, we examine group effectiveness within the Paper Chase program. Our facilitation and research teams included both faculty and graduate students.

**Methods:** We conducted pre-and post-questionnaires among participants in a Paper Chase event among 25 participants unfamiliar with one another prior to the exercise. We analyzed closed-ended responses using descriptive statistics and paired t-tests. Open-ended responses were analyzed using a content analysis approach.

**Results:** Findings show increases in positive attitudes toward teamwork, improvements in self-confidence, and collaborative skills (e.g., interpersonal communication). The structure of Paper Chase supported growth in teamwork abilities but also challenged some participants in their time management (e.g., need for mentoring) and breaking from individual-focused patterns.

**Discussion:** This approach is promising for other academic environments, including familiar and unfamiliar research teams.

## KEYWORDS

Paper Chase, rapid dissemination, teamwork, collaborative writing, science communication

## 1 Introduction

### 1.1 Writing skills in higher education

Becoming a skilled writer is essential in a student setting and meaningful in post-graduation employment. For undergraduates, moving from academic to workplace writing can challenge some students as applying concepts or skills outside their trained discipline may need clearer pathways (Inouye and McAlpine, 2023). This may be due to a need for more connection between theory and practice and a lack of experience applying analytical thinking through writing (Inouye and McAlpine, 2023). Several studies have shown employers seek students skilled in critical thinking, problem-solving, and written and oral communication (Sapp and Zhang, 2009; Schmitz and Havholm, 2015). In addition, writing skills have been

rated as one of the lowest skills possessed by students entering the workforce, suggesting that students might not be gaining the proper practice in their coursework that can translate to performance in the workplace (Sapp and Zhang, 2009). Therefore, understanding how to effectively teach students to become adept writers can impact long-lasting professional success.

## 1.2 Collaborative writing and learning

Collaborative writing, which involves two or more writers contributing to a text, has recently gained traction in academia (Deveci, 2018; Zhang and Plonsky, 2020). Collaborative writing involves writers in all aspects of the process, such as the decision-making, construction, and editing of a text (Deveci, 2018). As a result, it is a high-impact practice (i.e., practices with “significant educational benefit” for participants) by the Association of American Colleges and Universities due to its benefits in applying new knowledge to real-world applications (Kuh, 2008). Studies have found that collaborative writing results in texts with better grammatical accuracy, complexity, and task fulfillment (Elabdali, 2021; McDonough et al., 2018; Storch, 2005). In addition to allowing writers to gain experience in all aspects of writing, collaborative writing can also lower anxiety and raise self-confidence (Mulligan and Garofalo, 2011). Since there is a social aspect to collaborative writing, participants also learn to utilize social skills to promote accountability and cooperation from all team members (Mulligan and Garofalo, 2011). High-impact collaborative writing results in higher-quality writing and promotes other skills such as problem-solving, social agility in a group setting, and navigating feedback (Johnson et al., 2014).

Related to collaborative writing, learning to work and solve problems in the company of others benefits students (Kuh, 2008). Johnson et al. (2014) describe cooperative learning as an evidence-based instructional practice that can be successfully operationalized into instructional practice at higher-education institutions. With a theoretical foundation in social interdependence theory, collaborative learning has clear benefits that would not exist if students worked competitively or individually (Deutsch, 1962; Johnson and Johnson, 1989). Principles of cooperative learning include, 1. Clearly perceived positive interdependence; 2. Considerable promotive (face-to-face) interaction; 3. Clearly perceived individual accountability and personal responsibility to achieve the group’s goals; 4. Frequent use of the relevant interpersonal and small-group skills; 5. Frequent and regular group processing of current functioning to improve the group’s future effectiveness (Rogers and Johnson, 1994). For example, sharing ideas and models for understanding complex concepts benefits cooperative learning as students can consider different viewpoints outside their own (Johnson et al., 2014). Further, students may be influenced by group behaviors observed in the collaborative assignment and such leadership or work styles may be followed (Johnson et al., 2014). Notably, these experiences are only sometimes positive. The stress of group work can lead to negative feelings that discourage group work learning in the future.

Currently, some of the most common group learning formats in colleges and universities include collaborative learning, peer discussion, peer instruction, problem-based learning, team-based learning, process-oriented guided inquiry, and peer-led team learning (Hodges, 2018). While these formats are practical, student engagement

during group activities is vital for the outcome of the experience. A group formed to engage students constructively and interactively can lead to higher-order cognitive learning outcomes (Hodges, 2018). Early literature on group work in academia recommends that successful groups have mediating processes that promote an exchange of ideas that strengthen reasoning and higher-order thinking while allowing for cognitive processing and the reconciliation of varying opinions. In addition, successful groups should promote peer encouragement and acceptance of group members’ contributions (Bossert, 1988).

Instructors are often tasked with ensuring individual accountability and collaborative work (Alden, 2011; Murray, 2017). Due to its complexity, group work assessment can be challenging for instructors (Forsell et al., 2020). Complicating the already tricky task of measuring group effectiveness on academic projects, there has been a recent and rapid increase in the use of virtual instruction or pedagogical tools for collaboration (e.g., Google Docs) and group communication (e.g., Slack) at higher-education institutions (Ahmed, 2019; Zhou et al., 2012). Ultimately, evaluating group effectiveness during collaborative writing exercises provides participants with a reflective learning and growth opportunity.

## 1.3 Team science

Recently, there has been a growing practice in both research and academic institutions of team science whereby more than one individual conducts research in an interdependent fashion for small or large group collaboration. Hall et al. (2012) provide a framework for conducting transdisciplinary team-based research with public health and social science teams.<sup>1</sup> This model of four team-based research phases: development, conceptualization, implementation, and translation, can be applied to higher-education teams where learning and research opportunities are often interdisciplinary. The practice of team science can be modeled through academic research opportunities as a professional development exercise for research dissemination (Dahl et al., 2022; Perry et al., 2023). Collaborative writing can be a facet of team science, and both are enhanced through interdisciplinarity. For faculty members, this provides an opportunity to engage students in two high-impact practices: involvement in academic research and collaborative writing (Kuh, 2008). Such practices can help students develop career competencies sought after by employers, such as teamwork, communication, and critical thinking (Bhattacharyya et al., 2018; Gray, 2021; Schmitz and Havholm, 2015), making the effectiveness and assessment of group work essential.

Collaborative approaches to research dissemination include scientific writing accountability groups, writing retreats, and traditional relay formats where the manuscript is passed through authors in a sequential format. Commonly cited challenges with these collaborative writing models include collaborator response time,

<sup>1</sup> Hall et al.’s (2012) original language focused on transdisciplinary approaches. We recognize that the Paper Chase brings together participants from different disciplines, but may be more in line with interdisciplinary approaches given that manuscripts are often kept within the lead faculty’s discipline.

problem-solving, free riders, and competing responsibilities (Davies, 2009). To minimize these challenges, Schaumberg et al. (2015) describe a “Paper Chase” model where established research teams complete a manuscript draft from start to finish in a designated time frame by rotating paper sections and responsibilities throughout a 24-h working period. Compared to the original “Paper Chase” description or the “Paper in a Day” formats where a team may analyze data and draft a manuscript in a limited period (e.g., Larsen et al., 2023), our version of the Paper Chase offers the unique value of mentorship and facilitation combined with accessible pathways for involving students in research. Elements of our practice include the requirement of pre-analyzed data ready for dissemination (faculty responsibility), baseline training to ensure team readiness for the writing practice, facilitated group meetings ahead of the Paper Chase event, structured and facilitated writing blocks during the event, and bridging new connections through writing teams who may be unfamiliar with one another. In our format, students can engage in science communication without being a core member of the research team. These adaptations were included to set the exercise up as a learning opportunity, as compared to an exercise for skilled and established research teams.

## 1.4 Paper Chase program

In our adapted model, we use principles similar to those of Schaumberg et al.'s (2015) approach, with added elements of training novices through beginner researchers at the undergraduate and graduate levels on research dissemination. The purpose of the Paper Chase professional development training program is to be a structured and facilitated collaborative writing exercise focused on rapidly disseminating research, resulting in a complete draft of a manuscript ready for peer review. The program aims to increase equitable opportunities for engaging in academic research while developing interdisciplinary team science skills. Through a competitive application process, students interested in research and writing skill development were invited to participate in a faculty-led, team-based writing marathon in which roles and responsibilities rotate over 24 h spread over consecutive working days. Participants in our program work collaboratively towards a common goal (positive interdependence) with individual tasks and accountability in the exercise. Before the writing event, participants evaluate their own skills and discuss areas of contribution to the team. Using writing blocks and the iterative process of rotating paper sections for review and contributions requires frequent and regular group processing of current effectiveness in reaching the team's goals. Due to the collaborative nature of the writing exercise, all participants are eligible for authorship credit on the manuscript.

Paper Chase is a structured collaborative writing program; in this iteration, we matched faculty and students who were primarily unfamiliar with one another to prepare a manuscript for submission to a peer-reviewed journal. Held during the 2022 spring semester, this professional development exercise was built on our prior virtual model (Dahl et al., 2022). Based on the program evaluation feedback from our entirely virtual exercise during the COVID-19 pandemic, we used a hybrid model with asynchronous online learning modules and in-person collaborative writing exercises. Participants met with their teams two to three times virtually while completing the online

learning modules to acquaint themselves with the research project, discuss personal strengths, discuss the Paper Chase logistics, and begin to develop an outline. All participants were included as authors, with authorship order discussed amongst the groups during the Paper Chase event; any other collaborators were invited to contribute to the manuscript directly following the Paper Chase before journal submission. A stipend was provided to faculty (\$250) and students (\$500) who completed the online training and evaluation surveys and attended the Paper Chase event. See Figure 1 for a description of the overall process of the Paper Chase.

Finley (2019) points out, “The term ‘high-impact’ almost assumes efficacy,” but it is critical to evaluate such efforts to understand the extent of the impact beyond outcomes alone. With increasingly limited resources, colleges and universities must choose which high-impact practices to invest in Miller et al. (2018). Drawing on the increasing need for team science approaches and evidence of high-impact practices through collaborative writing and research experiences, we propose the Paper Chase program as a training opportunity for faculty and students of various levels. This study examined the effectiveness of a collaborative, structured team writing program (Paper Chase) among students and faculty across multiple disciplines. Attitudes toward group work and research collaboration skills were assessed. We hypothesized that the Paper Chase experience would increase participants' positive attitudes toward group work and research collaboration skills.

## 2 Materials and methods

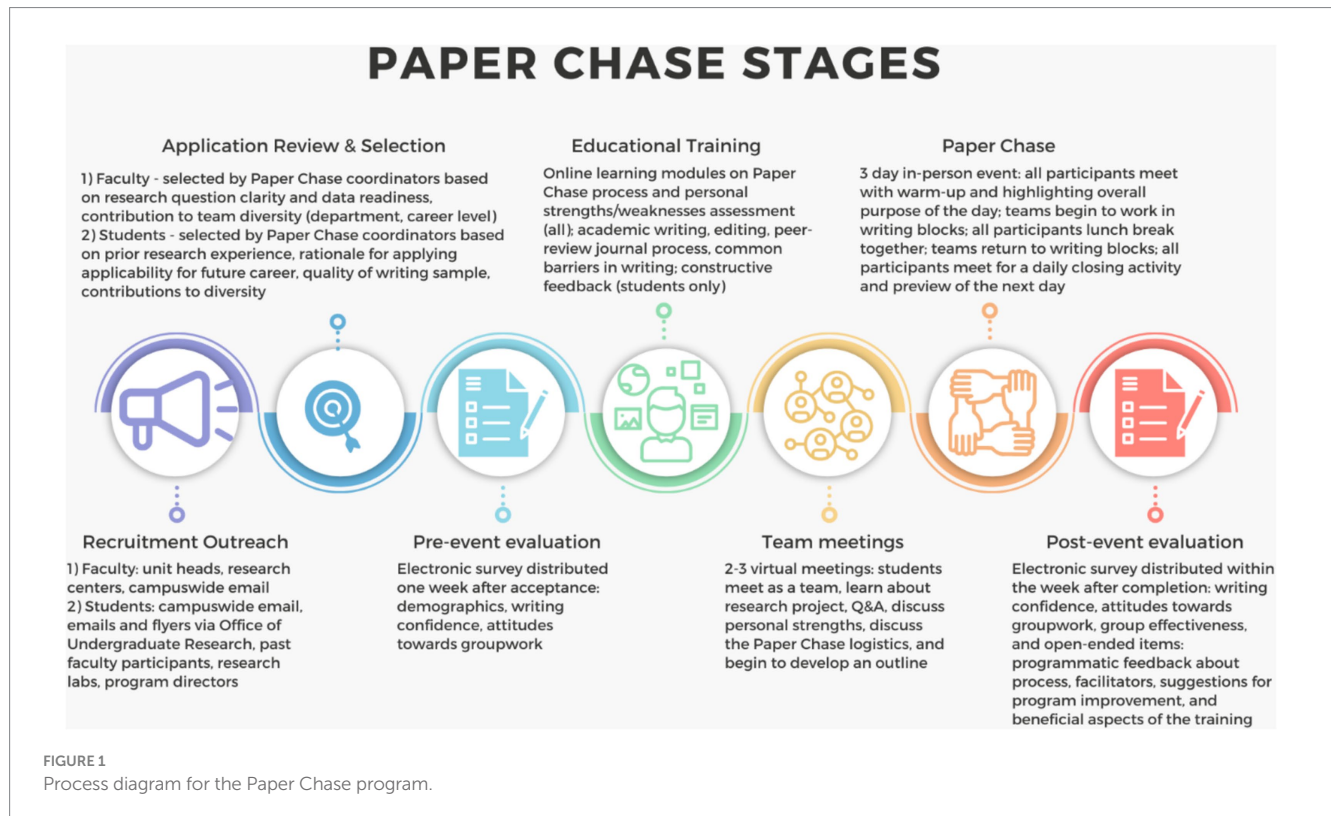
### 2.1 Design

Data presented in this paper are from a pre-post-evaluation survey of faculty and student participants in the “Paper Chase” program at a southeastern university in 2022. The lead author's institutional review board approved all procedures and protocols.

#### 2.1.1 Participants

Two faculty members (JM and AD) coordinated the program, selected applicants, coordinated graduate student facilitators, oversaw the Paper Chase event, and were part of the facilitation team. Faculty from across the institution were invited to submit a project abstract for data they owned that had yet to be published. Projects were selected based on the following criteria: the readiness of research findings, clarity of abstract, anticipated student appeal of the project, and diversity among faculty discipline area and demographics (i.e., race/ethnicity, gender). Four abstracts were selected covering diverse topics of social work education, public health, sexual health, and digital equity.

Students from any major were invited to apply and were asked to rank their preference for research projects. Student applications were scored by JM and AD and ranked using the following criteria: prior research experience, rationale for applying applicability for future career pathways, quality of writing sample, and contributions to diversity. There were no restrictions if students were past participants in previous Paper Chase exercises. Three faculty, 11 graduate (one of which had participated in the Paper Chase previously) and 12 undergraduate students (one previous participant) participated in the Paper Chase event.



### 2.1.2 Training and event

Student participants had to complete nine asynchronous online training modules (e.g., journal logistics, peer review basics, Paper Chase introduction) with instructional videos and associated activities. Modules were created by the Paper Chase coordinators (JM and AD) and hosted on a Learning Management System (Canvas). Faculty were also invited to access all modules but were only required to complete modules focused on the Paper Chase event and troubleshooting. This training helped all participants develop skills for research dissemination instead of concentrating on earlier aspects of research such as data collection and conducting research with human subjects. Paper Chase graduate assistants monitored module activity completion and sent reminders for missing assignments 1 week before their due dates.

The Paper Chase event was held on campus and in person over 3 days, with facilitators rotated daily. Depending on the team, participants had rotating roles for 45-min-to 60-min periods. Facilitators managed time troubleshooting during the Paper Chase event and established goals and roles for participants during each block. The Paper Chase coordinators trained facilitators in a 2-h training with a facilitation guide that was amended throughout the process as additional lessons were learned. Although faculty participants were considered experts in the field area, project, and findings, all team members were encouraged to take ownership of the manuscript product. The Paper Chase supported students' mentorship through a team science approach and collaborative writing with the following intentional steps: (a) throughout the modules and event, participants are reminded that every member has a valuable contribution, and that contribution is valued over perfection; (b) students were asked to read relevant research articles provided by the faculty to establish a baseline understanding of the subject matter; (c)

in the pre-team meetings, all members were asked to summarize their understanding of the study findings in their own words; (d) facilitators assigned specific writing tasks to each member during the exercise and were available to troubleshoot in the case of roadblocks. Facilitators asked participants to reflect on their self-identified skills and strengths, leading to a conversation about suggested roles on the team. These roles were assigned while balancing the priorities of ensuring that everyone contributed to all sections of the manuscript and that tasks from the previous time block were sufficiently resolved such that a new person could take over. To encourage growth and skill development, facilitators typically rotated participants to a new section or task assignment after no more than two consecutive writing blocks.

## 2.2 Measures

### 2.2.1 Pre-event questionnaire

Participants were asked to take an anonymous pre-survey through Qualtrics as part of the program requirements. Participants were presented with an electronic consent document followed by the questionnaire. The first five questions of the questionnaire were demographics (age, race/ethnicity, gender, degree program). Following, students responded to a 15-item writing confidence measure. We used seven items from the [Farrah \(2011\)](#) 32-item measure assessing writing confidence ("Working in groups helps me to have a greater responsibility for myself and the group"); we also added eight items specific to the Paper Chase (e.g., "I understand the process of submitting a manuscript to a peer-reviewed journal"). Attitudes toward group work were assessed using 15 items from [Marks and O'Connor's \(2013\)](#) evaluation



battery. An example item included, “Group work should be used more often in academia,” with five options ranging in level of agreement. Items not used in both original measures were focused on classroom environments (e.g., related to grading and course material). The remaining measure items were outside of the context of our project. Both writing confidence and attitudes toward group work were measured using a 5-item Likert scale of agree-disagree.

### 2.2.2 Post-event questionnaire

In the week following the Paper Chase exercise, participants were asked to complete a post-event questionnaire through Qualtrics with repeated measures from the pre-questionnaire. In addition, ten open-ended questions were posed to all participants to collect programmatic feedback about facilitators, recommendations, suggestions for program improvement, and beneficial aspects of the training. Lastly, a 56-question group effectiveness questionnaire (University of Colorado, n.d.), was presented using a 5-point Likert agreement scale to determine perceived group effectiveness attitudes regarding their Paper Chase team. Example items include “Working address and resolve issues quickly” and “People are proud to be a part of our team.” There were eight dimensions of responses: purpose and goals, roles, team processes, team relationships, intergroup relationships, problem-solving, passion and commitment, and skills and learning. The Cronbach’s alpha for this scale is 0.98 (Dittmer et al., 2020).

## 2.3 Analyses

Quantitative analyses of questionnaire data were performed using SPSS statistical software. Demographic variables were summarized with descriptive statistics. Students’ confidence and attitudes scores were calculated using the means of respective survey items. While exploring the descriptive statistics, two outliers were detected that were more than 1.5 box lengths from the edge of the box in a boxplot. Inspection of their values did not reveal them to be extreme, but rather an indicator of high confidence and attitudes prior to the exercise, so they were kept in the data set. Data were normally distributed otherwise. Pre- and post-survey data were analyzed with paired *t*-test, where mean scores were compared across the two time points to determine whether the student participants experienced an average change. One graduate student did not complete the attitudes and confidence survey items included in those quantitative analyses.

Group effectiveness scores for students and faculty were calculated with sample means and standard deviations. Five participants did not complete this portion of their survey, resulting in data presented for 21 participants. We did not explore these data by Paper Chase team assignment, as the teams varied in composition, and with a small sample, reporting findings on such a granular level presents a threat to confidentiality. Our report takes a cumulative look at group effectiveness across the collaborative writing event. Numeric values were attributed to each Likert survey response (1 to 5) and a cumulative sum for each item was calculated. Averages were then calculated for responses within each dimension to examine the differences between perspectives. In this assessment, an  $\bar{x}=88$  was established as the Team Effectiveness Score, calculated as an average of the eight dimensions. This serves as an indicator of high and low-performing dimensions.

Open-ended responses from the post-questionnaire were analyzed using content analyses (Hsieh and Shannon, 2005) with two coders coding in Excel (JM and AD). The codebook was created after a preliminary review of responses and separated by question (i.e., challenges, benefits, recommended for whom). After responses were coded, they were summed for their presence by participants. Coders’ reliability was calculated using simple agreement, with percent agreement ranging from 0.65 (broaden knowledge) to 0.94 (collaboration). See [Supplementary Table 1](#) for the full reliability percentages by code.

## 3 Results

Participant demographics are detailed in [Table 1](#). Most participants identified as women ( $n = 24$ , 92%), and the sample was racially diverse, with 53.8% identified as White, 30.8% African American/Black, 11.5% Asian, 7.7% Middle Eastern, and 3.8% Native American. Eight undergraduate students (66.7%), four graduate students (36.4%), and one faculty member (33.3%) are first-generation college students/graduates. Students represented various academic programs, with the most representation from programs in the College of Health and Human Services ( $n = 11$ , 47.8%) and the College of Liberal Arts and Sciences ( $n = 10$ , 43.5%). The remaining two students were enrolled in degree programs in education and computer science (8.7%). Before the Paper Chase program, 30.8% of participants ( $n = 8$ ) had never participated in a structured group activity before. See [Table 2](#) for a summary of themes with exemplar quotes from the open-ended responses, which are further described in the sections to follow.

### 3.1 Collaboration

The Paper Chase was reported to be highly acceptable in terms of collaboration and interdisciplinarity. One of the main benefits named by participants of the Paper Chase program related to collaboration ( $n = 21$ , 80.7%). With different skills, the team was helpful for some participants who described their team as “*well-rounded*” (Undergraduate student). One participant recommends the program to “*anyone looking to improve their ability to work on interdisciplinary teams with a bottom-line goal in sight*” (Graduate student). Some participants appreciated meeting new people, especially when students have limited opportunities to network outside of their discipline. “*...helped me network with others and make connections across departments*” (Graduate student).

The group effectiveness questionnaire dimensions and average scores for 21 participants are depicted in [Table 3](#). There were three categories that participants felt were not strong within their teams. They reported their lowest score as team roles ( $\bar{x}=81$ ), indicating they did not believe all participants in their team equally performed the same level of work in each role and were not valued in some of the roles they had. This may be a product of varying skills when entering unfamiliar teams, with some students having no experience and a larger learning curve in some aspects of the manuscript development. The second lowest score was an intergroup relationship ( $\bar{x}=86$ ), suggesting that members within a group did not feel there was good communication between *other teams* to set goals, resolve conflict, and support each other. However, they scored high in team relationships

TABLE 1 Demographic information on the Paper Chase Event.

		Undergraduate student (n = 12)	Graduate student (n = 11)	Faculty (n = 3)	All participants (N = 26)
Gender (n, %)	Woman	10 (83.3)	11 (100)	3 (100)	24 (92.3)
	Man	2 (16.7)	0 (0)	0 (0)	2 (7.7)
Race/Ethnicity (n, %)	African American/Black	2 (16.7)	4 (36.4)	2 (66.7)	8 (30.8)
	Asian	3 (25.0)	0 (0)	0 (0)	3 (11.5)
	Middle Eastern/North African	2 (16.7)	0 (0)	0 (0)	2 (7.7)
	Native American	1 (8.3)	0 (0)	0 (0)	1 (3.8)
	White	7 (58.3)	6 (54.5)	1 (33.3)	14 (53.8)
Ever participated in clearly structured writing groups (n, %)	Never	2 (16.7)	5 (45.5)	1 (33.3)	8 (30.8)
	Once a year	4 (33.3)	1 (9.1)	0 (0)	5 (19.2)
	1 or 2 times	6 (50.0)	3 (27.3)	2 (66.7)	11 (42.3)
	Frequently	0 (0)	2 (18.2)	0 (0)	2 (7.7)
First Gen (n, %)	Yes	8 (66.7)	4 (36.4)	1 (33.3)	13 (50.0)

TABLE 2 Summary of themes and subthemes (noted with positive or negative effect) with exemplar quotes from participants.

Collaboration + Meeting new people	“[Who would you recommend the Paper Chase to?] <i>anyone looking to improve their ability to work on interdisciplinary teams with a bottom-line goal in sight</i> ” (Graduate student)
Collaboration: <i>Confidence and attitudes</i> + More collaborative and participatory than previous experiences with group/team work + Increases in trust and professionalism + Gaining a sense of personal preference regarding independent versus team work + Moving past anxieties and perfectionism to build confidence	“ <i>This was a great experience working with people and allowed me to see a brighter side to working with a group. I was able to bounce ideas off different individuals and learn from my group mates.</i> ” (Undergraduate student) “ <i>I was motivated to finish the paper because I had a team holding me accountable. Learning to trust students even more in their capabilities</i> ” (Faculty member) “ <i>I joined this process with the intent to learn, so I did not think I had the skills on day one to be of use to the group. Once I realized that most felt that way, and that I had a great support group to rely on, I was able to relax and focus.</i> ” (Undergraduate student)
Skills for collaborative writing + Increasing communication skills +/- Choosing to manage others or not + Enhanced writing and editing skills	“ <i>It expanded my interpersonal abilities in being able to manage differing opinions and styles while directing individuals towards the main goal and ensuring we spend more time writing than discussing</i> ” (Graduate student) “ <i>I felt my group was often off-task or could not stay on schedule because of group conversations that may or may not have been on-task. I was able to keep my cool and, at times, give gentle nudges to help us stay on task.</i> ” (Graduate student) “ <i>I had to get used to writing over other people’s work, and having other people write over mine.</i> ” (Graduate student)
Structure of the Paper Chase + Structured discussions - Process does not lend faculty usual control - Lack of individually focused mentoring or feedback	“ <i>I really enjoyed going through the writing together at the end of the day and making plans for the next day. On the last day having live discussions as we all edited together was a great process that allowed us to hash out confusions, refine ideas and share different perspectives efficiently.</i> ” (Graduate student) “ <i>If the professor over identifies with the research or paper, then it may not be a good fit as they will not allow the students to have a voice in the process</i> ” (Faculty member) “ <i>It was at times difficult to adequately mentor students with such different research experience and keep track of each of their progress</i> ” (Faculty member)

( $\bar{x}=91$ ), suggesting that members felt they did a good job supporting each other, setting goals, and resolving conflict. The third lowest score identified was skills and learning, which suggested that participants felt room for improvement in self-growth and learning throughout the process. Nevertheless, participants scored high on problem-solving skills ( $\bar{x}=91$ ), suggesting that even though they were not entirely comfortable with every role or task of the Paper Chase event, they felt they could problem-solve by themselves and with the team to overcome those challenges.

Part of the collaboration was built into the structure of the process. “*I really enjoyed going through the writing together at the end of the day and making plans for the next day. On the last day having live discussions as we all edited together was a great process that allowed us to hash out confusions, refine ideas and share different perspectives efficiently.*” (Graduate student). The structured discussions helped participants understand the research, enhancing their contributions. “*Openly discussing the research helped me to improve upon my explanation of themes and my understanding of the material*” (Graduate

TABLE 3 Group effectiveness dimension scores ( $n = 21$ ).

Dimensions	Score average ( $\bar{x}$ )
Team relationships	91
Problem-solving	91
Passion and commitment	91
Purpose and goals	89
Team processes	89
Team effectiveness score:	88
Intergroup relations	86
Skills and learning	86
Roles	81

student). Relatedly, one faculty member would not recommend the program to other faculty if they were overly attached to the research. *“If the professor over-identifies with the research or paper then it may not be a good fit as they will not allow the students to have a voice in the process”* (Faculty member).

We held initial team meetings online before the in-person event, and for those with anxieties, a lack of interpersonal connections online was alarming. *“Initially, meeting my group members over Zoom gave me little hope for our project ... meeting these people in person was great and there were no hiccups during the actual in-person event ... It is not ideal to have the first meetings of the group be online, as personalities are entirely different when people are behind a screen”* (Undergraduate student). Facilitators supported interpersonal connections in the group approximately halfway through the event by encouraging members to write anonymous notes of encouragement and appreciation to one another.

To a lesser extent, the feasibility of collaborative work was seen as a challenge ( $n = 8$ , 30.8%). Both graduate and undergraduate students reported choosing to manage others or not. *“I felt my group was often off-task or could not stay on schedule because of group conversations that may or may not have been on-task. I was able to keep my cool and, at times, give gentle nudges to help us stay on task.”* (Graduate student). For some, Paper Chase did not improve their skills due to the group-focused nature of the process. *“[What was challenging about the Paper Chase?]: the ability to receive feedback on writing”* (Graduate student). Another faculty pointed out the high demand for mentoring in a time-limited environment. *“It was at times difficult to adequately mentor students with such different research experience and keep track of each of their progress”* (Faculty member).

### 3.2 Confidence in writing

Results from 17 students' self-assessed confidence in academic writing increased significantly from pre- ( $M = 3.96$ ,  $SD = 0.42$ ) to post-test ( $M = 4.30$ ,  $SD = 0.51$ ,  $p = 0.010$ ). In open-ended responses, participants mentioned writing skills, including speed, editing, and technology (using software programs like Zotero to manage references;  $n = 21$ , 80.7%). *“The process improved my ability to work and write as part of a team. It also improved my ability to generate content and write quickly without being defeated by perfectionism.”* (Graduate student). Another facet of writing included editing. *“I had to get used to writing over other people's work and having other people write over mine.”* (Graduate

student). Some participants noticed growth in their communication skills, especially among graduate students who may receive training on conventions and norms in their research and/or writing discipline. *“It expanded my interpersonal abilities in being able to manage differing opinions and styles while directing individuals towards the main goal and ensuring we spend more time writing than discussing”* (Graduate student).

### 3.3 Attitudes toward teamwork

Similarly, there was an increase in students' attitudes around teamwork because of Paper Chase participation from pre- ( $M = 3.34$ ,  $SD = 0.52$ ) to post-test ( $M = 4.07$ ,  $SD = 0.65$ ,  $p < 0.001$ ). Qualitative results from all participants confirmed these findings. Attitudes toward teamwork were positively influenced for the most part. Both students and faculty have often experienced ineffective group writing before participating in the Paper Chase. Rather than only contributing, participants appreciated learning from others while writing. *“This was a great experience working with people and allowed me to see a brighter side to working with a group. I was able to bounce ideas off different individuals and learn from my group mates.”* (Undergraduate student). One student contrasted this with prior collaboration work. *“I really loved seeing how we all divided and conquered and then through the iterative editing process were able to have a collaborative manuscript that everyone has shared ownership over. Especially since in academia, it often feels like one or two people write the entire manuscript and not only is it long and drawn out, it does not feel like the co-authors co-authored”* (Graduate student). One faculty member highlighted the importance of professionalism, accountability, and trust. *“I was motivated to finish the paper because I had a team holding me accountable. Learning to trust students even more in their capabilities”* (Faculty member). Some participants mentioned that collaborative writing was not their preference. *“I learned that I prefer to independently spend extended blocks of time on my work”* (Undergraduate student).

Attitudes toward teamwork were, at times, influenced by participants' attitudes toward their abilities. Many participants mentioned perfectionism or fears they “were not good enough” ( $n = 10$ , 38.5%); the Paper Chase helped them to move past these general anxieties and gain self-confidence as they collaborated with others ( $n = 9$ , 34.6%). One participant learned to *“be more confident in my brainstorming/writing skills”* (Undergraduate student). Specifically, the structure of the Paper Chase enabled some to release their anxiety. *“I joined this process with the intent to learn, so I did not think I had the skills on day one to be of use to the group. Once I realized that most felt that way, and that I had a great support group to rely on, I was able to relax and focus.”* (Undergraduate student).

## 4 Discussion

Collaborative writing and research engagement are considered high-impact educational practices for students that provide skills connected to career competencies, such as teamwork, communication, and critical thinking (National Association of Colleges and Employers, 2024). To enhance team science, more interdisciplinary skill development programming is needed (Casson et al., 2018). Universities have invested in high-impact educational practices; however, as campus resources become more constrained, the need to

understand the impact of professional development programs grows. The assessment of high-impact practices should be more holistic rather than solely focusing on narrow outcomes such as grade point average (Finley, 2019).

Overall, the Paper Chase program was perceived as highly acceptable and feasible for enhancing collaboration, confidence in writing, and teamwork. Participants' skills (e.g., interpersonal communication, writing skills) and attitudes (e.g., self-confidence) were enhanced through their involvement in the program. As in previous literature, participants reported that collaborative writing lowered their anxiety compared to sole-author writing (Mulligan and Garofalo, 2011). The practice appears to be critical—beyond feedback from others, participants described the integration and act of contributing to the shared manuscript as decreasing anxiety. These experiences helped to build confidence and diminished imposter syndrome. The structure of the Paper Chase can assist in constructing identity and reduce anxiety through a sense of safety. This may translate to students entering the workforce with an openness to grow and contribute to spaces where they are novices.

The group effectiveness questionnaire responses identified areas that can be improved and areas that worked in preparation for creating an effective group using the Paper Chase method. The findings also suggested that participants felt that the Paper Chase method created an effective team environment in five of the eight categories, with the others still scoring over 80. For team effectiveness, Haas and Mortensen (2016) suggest assessing the following: output (manuscript quality), collaborative ability (dynamics of the team such as all members contributing), individual development (skills in writing and research), and conditions for effectiveness [compelling direction (common goal of manuscript), strong structure (facilitated pre-team meetings, writing blocks of event), supportive context (online modules for training), and shared mindset (common identity)]. We find evidence of positive team effectiveness in all Haas and Mortensen's criteria except one: the last facet of common identity may be underdeveloped with the interdisciplinary and accelerated timeline of the Paper Chase program (Haas and Mortensen, 2016). A shared group identity may increase accountability and decrease anxiety.

A supportive context facilitates team effectiveness, which may be built both internally and externally. In addition to online training to assist participants in feeling prepared to engage in Paper Chase activities, team members may also help others feel supported. We see this evidence through members "nudging" one another to stay on task during the Paper Chase exercise. When all team members are accountable not for a grade but for their intrinsic motivation, participants described increased productivity and reduced fears. Participants can develop more encouraging relationships through morale boosters (such as anonymous notes of appreciation from team members). Although the Paper Chase program has support to reduce the burden of mentorship on faculty participants (e.g., students learning modules about the peer review process and editing another's work), faculty may need additional training to address mentorship during a structured process like the Paper Chase.

Among those in higher education, Paper Chase shows evidence of building the National Association of Colleges and Employers' career competencies (National Association of Colleges and Employers, 2023). Participants report improvement in their communication, teamwork, professionalism, and, to a lesser extent, technology skills. Intensively working with others improves diversity and inclusion

skills, as participants report broadening their understanding of other disciplines' ways of thinking and adapting to a new environment. Working on a research manuscript employs critical thinking skills and advances career skills. We expect these skills to be transferable to a variety of careers.

Related to career competencies, participants need people skills to collaborate in research teams and sustain collaboration (Gibert et al., 2017). Based on our findings, Paper Chase fosters the following people skills based on Gibert et al.'s (2017) 14 list of people skills: networking, decision-making, and flexibility. To a lesser degree, the Paper Chase program may contribute to other people's skills, such as initiative, empowering the talents of others, and resilience (specifically regarding time pressure receiving feedback).

Team science is needed to address complex contemporary challenges, and we find evidence of our Paper Chase supporting team science (Hall et al., 2018; Perry et al., 2023). Hall et al.'s phases of team science include (a) the development phase (i.e., establish a shared mission, psychological safety), (b) the conceptualization phase (i.e., solidify research questions, hypotheses, conceptual framework), (c) implementation phase (i.e., conduct the planned research activity), and (d) translation phase (i.e., advance the discovery-development-delivery process). We support the development phase through the initial team meetings to increase a sense of safety. The conceptualization phase is aided by the ongoing group conversations that begin virtually before the event, while the implementation phase occurs during the event (as described by Perry et al. (2023)). Our version of the Paper Chase does not include structured continuity past the event itself, and the onus of translation rests primarily with the team's lead. However, we support translational impacts in the following ways. Our participants are trained in infographics and develop them for their projects to support dissemination through social media. Involving unfamiliar undergraduate students in research projects can create new interest areas, increase persistence in STEM fields, and affect their graduate trajectories (Carpi et al., 2017; Dahl et al., 2022; Kuh and O'Donnell, 2013; Russell et al., 2007). Some participants report maintaining connections with other students or faculty due to involvement in the program, increasing their likelihood of collaborating in the future.

## 4.1 Strengths and limitations

This collaborative professional development exercise was structured to support accessible pathways to research participation for students who may not be able to engage in a long-term research role. Virtual team meetings ahead of the event provided opportunities for group formation to decrease feelings of social anxiety about working with largely unfamiliar teams. While we aim to make research more accessible, we acknowledge the workload of participation in the Paper Chase on faculty and students.

We rely on self-report measures for this evaluation. The design of the Paper Chase program requires that all team members write and edit writing products. Skills such as interpersonal communication often occur in unobservable contexts (e.g., in one-on-one dialogues between team members). These realities of the program make more objective assessments challenging. Future research may include more data points and/or longitudinal evaluation of these skills. Of potential interest to universities would be the long-term return on investment



of professional development programs such as Paper Chase. These data were collected in a short window of time, with the final assessment occurring within a week of the event. This may limit the reflection of the process, recognition of skills gained, and the long-term benefits of participation.

A notable limitation of our work is that the sample was a non-probability sample, in that it is likely that individuals who are predisposed to collaborative work are more likely to sign up for this type of program. The limitations of our small sample size are mitigated in some respects by including multiple teams and both quantitative and qualitative measures. Our sample predominantly consisted of cisgender women, who are often socialized to be collaborative. Cisgender women continue to carry the brunt of menial tasks in academia (e.g., taking minutes, making copies), which may translate into disparities in publication outcomes or fewer connections with highly productive researchers (Rua-Gomez et al., 2022; Social Sciences Feminist Network Research Interest Group, 2017). Collaboration may be necessary for marginalized populations, including cisgender women but also Black, Indigenous, and People of Color (BIPOC), to improve productivity (van der Wal et al., 2021).

## 5 Conclusion

Among unfamiliar participants, the Paper Chase program increases skills and attitudes about collaborative writing and teamwork in academic environments. Notably, many participants increased trust in others and confidence in themselves. With an increasing need for collaborative approaches in research, these skills prepare faculty and students to engage productively with others while facilitating high-impact professional development. This approach can be replicated with other populations, and our findings suggest that familiar teams may increase feelings of safety and identity, which will improve collaborative skills building further.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by University of North Carolina at Charlotte. The studies were conducted in

accordance with the local legislation and institutional requirements. The ethics committee/institutional review board waived the requirement of written informed consent for participation from the participants or the participants' legal guardians/next of kin because electronic consent was provided by participants.

## Author contributions

JM: Conceptualization, Formal analysis, Funding acquisition, Methodology, Supervision, Writing – original draft, Writing – review & editing. AD: Conceptualization, Formal analysis, Funding acquisition, Methodology, Supervision, Writing – original draft, Writing – review & editing. AF-B: Formal analysis, Writing – original draft. HP: Writing – original draft.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2025.1405449/full#supplementary-material>

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