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Guiding Collaboration: Exploring Teaching Assistants' Views

on Group Work in Higher Computer Science Education

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BACHELOR THESIS

Abstract

Abstract

Group work is a core component of computer science education, yet students frequently encounter difficulties when collaborating. While much research has focused on student and instructor perspectives, the role of teaching assistants (TAs) in supporting collaboration remains underexplored. This study investigates the challenges and potential solutions to student collaboration as observed by TAs. Through the first round of semi-structured group interviews with experienced TAs, key obstacles were identified, including social issues, unclear task division, uneven participation, and limited opportunities for TA intervention. Based on these findings, a practical guideline was developed to support TAs in proactively addressing group-related issues. The guideline was evaluated in a follow-up interview round, where TAs assessed its relevance and feasibility. The results suggest that even modest structural changes—such as regular check-ins and clearer expectations—can enhance both group dynamics and TA involvement. This thesis underscores the value of incorporating TA perspectives into course design to improve group work in higher education computer science.

Contents

1 Introduction

Collaboration plays a central role in higher education, particularly within computer science curricula [KI23]. Students are regularly tasked with group assignments that mimic real-world professional environments. While these experiences offer opportunities to develop both technical and interpersonal skills, they are often fraught with challenges related to group dynamics, communication, and accountability [DLSK23]. Although prior research has extensively examined the perspectives of students and instructors, the role of Teaching Assistants (TAs) in supporting group work remains underexplored.

TAs often act as the primary point of contact for students during practical labs and project-based courses, positioning them uniquely between students and course instructors. Their proximity to students allows them to observe group interactions more directly and respond to emerging issues. However, their ability to influence group processes is frequently limited by structural constraints and unclear expectations. Understanding how TAs perceive and manage collaboration is essential to improving the design and support of group work in higher education computer science.

This study aims to examine how TAs experience group collaboration among students, the obstacles they observe, and the strategies they believe can enhance group work. By doing so, this thesis aims to integrate the TA perspective into improving course design for group work.

1.1 Research Questions

This study examines how TAs in computer science education experience and evaluate student collaboration. The central research question is:

> *What are the challenges and potential solutions to student collaboration in computer science, from the perspective of teaching assistants?*

To answer this question, the following sub-questions are addressed:

1. What challenges do TAs observe in student collaboration?

2. What potential solutions do TAs suggest to address these challenges?

3. How do TAs evaluate the potential impact of these solutions, as presented in a formal guide, on group collaboration?

1.2 Overview

The thesis is structured as follows. Chapter 2 reviews relevant literature on collaboration in computer science education, common group work challenges, and the existing role of TAs. Chapter 3 outlines the methodology, including participant selection, data collection, and analytical approach. Chapter 4 presents the results from two rounds of interviews, highlighting key themes related to TA experiences, student challenges, and perceived solutions. It also describes the development and evaluation of a TA guideline. Chapter 5 discusses the findings in relation to prior research, reflects on the implications for course design, and concludes with limitations and directions for future research.

2 Related Work

2.1 What is collaboration

Collaboration plays an essential role in higher education computer science [Mag23]. In modern computer science programs, students are often required to work together on assignments, practical labs, and larger projects. Rochelle and Teasley describe collaborative work as a strong interaction over the whole time to work on the components of the solution [RT95]. Most of what we currently know about the effects of collaborative work comes from a large amount of research on pair programming (PP). In PP, two students work together at the same time on the same piece of code. Each student has a different role: one is the "driver", who writes the code, and the other is the "navigator", who checks each line of code. The students switch roles regularly. Studies show that PP has several positive effects [SMG11]. Overall, reviews and meta-analyses have found that PP improves student performance in programming courses. PP is the most commonly used method for organizing collaborative learning in computer science, although other methods are also used.

One such method is think-pair-share (TPS), which also supports collaborative learning. In TPS, students first work alone, then in pairs, and finally share their ideas with the whole class. Kothiyal [KMI14] used TPS in large computer science classes (about 450 students) during programming lessons. They found that students using TPS performed much better than those learning through lectures. Depending on how TPS is used, it might be seen more as a cooperative method than a collaborative one.

Peer instruction (PI) is another collaborative technique. In PI, students first answer a question on their own, then discuss it with classmates, and finally answer it again individually. This method increases the number of correct answers. Porter [PBLSZ11] found that PI had positive effects on student learning in computer science.

The collaboration method this thesis will focus on is group work. Group work is defined as assignments or projects that have 3 or more participants. Courses in modern Computer Science programs are filled with such group work assignments. At Leiden University there are several courses dedicated to teaching group work. https://studiegids.universiteitleiden.nl/studies/9974/informatica#tab-1

2.2 Relevance

In order to fully prepare students for professional environments, it is important to understand the educational value of collaboration within computer science curricula. This approach is not only a way to manage workload but also reflects how work is organized in the real world. Most jobs in the tech industry, especially in software engineering, involve working in teams. Whether it is pair programming, agile development, or larger cross-functional collaborations, teamwork is a core part in this field. Because of this, collaboration is not just an optional skill—it is one of the foundational abilities that computer science graduates are expected to have. Studies show there are several reasons why group work is an important part of a complete computer science education.

First of all, group work in computer science education prepares students for these real-world expectations. At the University of Reading, educators emphasize that "group work is an important aspect of the Computer Science degree, as generally in industry graduates work with others on various projects" [MP18]. This connection between university projects and industry practice shows that group work is not only a pedagogical tool but also a form of professional training. Students who participate in structured collaborative tasks are better prepared to work in the collaborative environments they will encounter in their careers.

Second, collaboration allows students to develop a wider range of skills than individual work alone can offer. While working in groups, students practice not only coding or problem-solving but also communication, coordination, leadership, time management, and conflict resolution. These are commonly referred to as "soft skills" and are increasingly in demand [HHS13]. Employers today are not just looking for people who can write code—they want employees who can explain their ideas, manage tasks, give and receive feedback, and work effectively with others under pressure [SFC01]. By practicing these skills during their studies, students can become more well-rounded professionals.

Lastly, the importance of collaboration is also supported by findings from the industry itself. In a study by Deniz Akdur [Akd22], which analyzed the gap between university training and industry expectations in software engineering, teamwork was consistently highlighted as a key skill valued by employers. The study involved feedback from software practitioners who described how collaboration is central to most software development tasks. They noted that being able to contribute effectively in a team is often just as important as technical ability. This means that students who lack teamwork experience may be at a disadvantage when entering the job market, even if they are strong programmers.

In summary, collaboration is a vital part of computer science education because it reflects industry practice, helps students build important soft skills, and prepares them for their future careers. Understanding why collaboration is important sets the stage for identifying the challenges students face in group work and exploring how teaching assistants might help address them.

2.3   Obstacles observed by students and educators

While collaboration is widely seen as an important part of computer science education, its implementation in academic settings is suboptimal. Both students and educators have pointed out several challenges that make group work difficult and, possibly, ineffective. Research focused on educators and students mainly identify four obstacles.

One of the core issues is the lack of intentional instructional design. As Schulz et al. [SSH23] demonstrate, many computer science courses introduce teamwork without providing sufficient scaffolding, such as guidance on collaboration strategies or use of shared digital tools. As a result, students frequently feel uncertain about how to participate productively in group settings. Instead of gaining experience in meaningful collaboration, they are left to self-organize, which often results in confusion, frustration, and dysfunctional group dynamics. These findings expose a structural challenge: academic institutions routinely treat collaboration as a generic skill that students will

acquire on their own. This assumption neglects the reality that teamwork, especially in a technical and often individualistic field like computer science, requires careful pedagogical planning. Designing for collaboration involves setting clear expectations, defining roles, and embedding feedback mechanisms throughout the course. When these elements are missing, students are unlikely to develop the collaborative competencies that modern computing practice demands.

Several studies reinforce this conclusion. For example, in an analysis of teaching teamwork in computer science [LB11], research explains that many programs expect students to develop collaboration skills just by doing group projects. However, they argue that this is not realistic. Students are unlikely to learn how to work well in teams unless they are given proper support and training. Without clear goals, roles, and feedback, students may repeat the same mistakes in every group assignment without ever learning how to improve.

Secondly, an issue relating to how group work is experienced by students themselves. Adding more project-based courses or requiring more group assignments does not necessarily lead to better collaboration. In fact, study by William M. Waite et al. [WJDL04] warns that these efforts can backfire if educators do not understand the specific student culture in computer science. Many students tend to value individual work and clear technical tasks over more social and process-based aspects of teamwork. This cultural factor means that collaboration must be taught intentionally, rather than assumed to develop naturally.

Problems with the way work is divided in groups are also very common [vdMA21]. Students often divide group assignments into individual parts that are completed separately. While this may seem like an efficient strategy, it reduces the opportunities for actual collaboration and shared learning. When students only focus on their part of the assignment, they may miss out on understanding how different parts of a system connect, or how to resolve conflicts and integrate ideas from others.

In addition to structural and cultural challenges, there are also social and ethical concerns. One of these is the issue of plagiarism. As noted by additional research [Fra14], some students are hesitant to fully share their work with others in the group due to fears of having their work copied or misused. This fear creates a barrier to open communication and trust, which are essential for successful teamwork. At the same time, in group settings where not all contributions are visible or easy to track, it becomes harder to identify whether everyone has contributed equally—or whether some students have copied work from others. These dynamics raise questions about fairness and accountability—issues that are rarely tackled in the instructional design of group assignments.

Taken together, these studies show that while group work is a valuable educational tool, it also comes with significant challenges. Students often do not receive enough training in collaboration, struggle with unclear roles, and face cultural, ethical and social issues that interfere with teamwork. Educators may assume that these problems will solve themselves as students gain more experience, but the research suggests otherwise. Without thoughtful instructional design group work may not lead to the desired learning outcomes. This highlights the need for targeted interventions that address these specific issues and support students in learning how to collaborate effectively.

2.4 The role of Teaching Assistants

Teaching Assistants (TAs) play an essential role in higher education, particularly in computer science programs. They are often the first point of contact for students during practical sessions, and they support both the learning process and the teaching goals of the course. Their responsibilities typically include leading lab sessions, answering student questions, providing feedback, and grading assignments. Since many TAs are former students of the same courses they now support, they occupy a unique position between students and faculty members. This allows them to serve as both mentors and facilitators of learning. As earlier described students and educators have been broadly researched.

While much research has focused on the perspectives of students and, to a lesser extent, educators, the role of TAs has received comparatively little scholarly attention. Most studies on collaborative learning center on student outcomes or instructional design decisions made by faculty, leaving a gap in our understanding of how TAs perceive, influence, and facilitate collaboration. This underrepresentation is striking given the pivotal position TAs occupy in day-to-day educational practice, especially in large-scale computer science programs where they often serve as the primary point of contact for students.

According to a study done at the Georgia Institute of Technology [BPN+25], TAs now take on a wide range of responsibilities that include technical support, mentoring, administrative tasks, and student guidance. More importantly, the study highlights how many TAs view their work not just as functional, but as deeply human-centered. This includes supporting students emotionally, inspiring them academically, and helping them feel more connected in their learning environment.

The study identifies four key roles that TAs often adopt: helper, inspirer, administrator, and bridger. The most common role was that of the helper, where TAs see their job as providing both basic and advanced academic support. This could range from answering technical questions to helping students understand difficult course concepts. Some TAs even described their role as helping students "learn how to learn," showing their commitment to supporting not just academic outcomes but the learning process itself.

The second role, inspirer, reflects how TAs often try to motivate students and spark interest in computer science. Many TAs reported that they found joy in seeing students become excited about the subject. They understood their influence as early role models, especially for first- or second-year students who are just beginning to form their identity as computer scientists.

In their administrator role, TAs assist instructors by handling practical tasks such as grading, organizing lab materials, and running help sessions. While these responsibilities may seem less visible, they are crucial for maintaining the smooth operation of large and complex computer science courses.

Finally, the study discusses the role of TAs as bridgers—people who connect students and faculty. Because TAs are often closer in age and experience to the students, they are seen as more approachable and less intimidating than professors. This makes them valuable intermediaries who can relay student concerns and explain course content in a way that is more relatable.

This division of TA roles is supported by several other studies in the field of computer science education research [RK20]. The recurrence of these categories across different contexts suggests that they capture core aspects of TA responsibilities in a meaningful way. However, while this framework is useful for understanding the diversity of TA functions, it may also risk oversimplifying the complex and dynamic nature of TA work. In practice, these roles often overlap, shift depending on the course structure, and are shaped by institutional expectations and the individual backgrounds of TAs. A rigid application of this model could therefore obscure important nuances in how TAs navigate their responsibilities and develop their teaching identities.

An interesting perspective in research on TAs highlights the distinct contrast between their preparation and that of faculty members. Unlike professors, who typically receive formal training in pedagogy and instructional design, TAs often rely primarily on their own prior learning experiences to navigate their instructional responsibilities. This reliance on personal academic experience can shape their teaching approach in both productive and limiting ways, as it may not always align with evidence-based teaching practices. A study by Marzouk et al. [Rie18] underscores this disparity, revealing that many TAs adopt instructional strategies based on what worked for them as students, rather than drawing from structured pedagogical training. This finding emphasizes the need for more comprehensive support and instructional development opportunities for TAs, particularly given their pivotal role in undergraduate education in computer science.

At the same time, several important questions remain unanswered. How do TAs themselves understand their role in supporting or facilitating group work? Do they feel equipped to handle interpersonal challenges, such as unbalanced participation or group conflict? And perhaps most crucially, what kinds of interventions or support structures do TAs believe would make collaborative assignments more effective? Future research should explore these questions in greater depth, not only to improve TA training but also to better align teaching practices with the realities of collaborative learning as experienced on the ground.

In summary, TAs are not just assistants—they are central figures in the learning environment. They help deliver course content, support student learning, and maintain communication across different levels of the educational process. Their dual perspective as both former students and current instructors makes their insights especially valuable, particularly when it comes to understanding and improving group collaboration. This highlights the importance of studying the experiences and perspectives of TAs in order to improve teamwork in higher education computer science.

3 Methodology

3.1 Participants

This study involved six participants with experience as TAs in computer science education. Eligible participants included both current and former TAs, regardless of whether they were affiliated with the Leiden Institute of Advanced Computer Science (LIACS) or another institution. The primary selection criterion was recent experience in facilitating student collaboration within practical or project-based computer science courses. This allowed for a diverse range of perspectives, including

those who had supported programming, theoretical, or mathematical subjects. Many participants had previously completed the courses they supported, granting them a dual perspective as both students and instructional facilitators. Their insights were particularly valuable for understanding the dynamics of group work and the challenges faced by students in collaborative settings.

3.2   Procedure

The study consisted of three main phases: interviews with TAs, the creation of a guideline derived from the findings of the initial interviews, and concluding interviews. To recruit participants, outreach was conducted through academic networks, including direct contact with current and former TAs in computer science programs. Recruitment was open to those with recent TA experience, regardless of their current institutional affiliation. Interested individuals were informed about the study's goals and timeline and were invited to participate voluntarily.

In the first phase, semi-structured in person interviews were conducted individually or in pairs. Each interview lasted approximately 30 to 45 minutes and was audio-recorded with the participant's consent. The interviews focused on TAs' experiences with group collaboration among students, challenges they observed, and strategies they believed could improve teamwork in academic settings. The second phase involved the development of a set of preliminary guidelines for TAs, based on the insights from these interviews. These guidelines aimed to provide practical, low-effort strategies that TAs could use to support student collaboration more intentionally during lab sessions or group assignments.

In the final phase, a individual or pair interviews were held with all participants. This session served to reflect on the document, evaluate the usefulness of the guidelines, and discuss any potential changes in group dynamics. The group interview was also audio-recorded and transcribed for analysis.

3.3   Interviews

This study employed a semi-structured interview approach to collect qualitative data. This method allowed the researcher to cover all relevant topics while also leaving space for natural flow and elaboration during the conversation. Two rounds of interviews were conducted: an initial round of individual or pair interviews and follow-up interviews with the same format.

The first interview round focused on the participants' background, their experience as TAs, and their observations of group collaboration among computer science students. Key topics included common challenges in teamwork, such as uneven participation or lack of structure, as well as potential interventions or strategies TAs believed could help address these issues. The semi-structured format ensured that all relevant research questions were covered, while also allowing participants to reflect on and share personal experiences in depth. The interview guide for this round can be found in Appendix A.

The second round consisted of interviews with the same participants. The interviews began with a review of the main insights from the first interview round, which were presented visually to

prompt reflection. Participants were then asked to evaluate the practical guideline that had been derived from the interviews in the first round. Specific topics included the possible impact of the guideline on student collaboration, the feasibility of applying it in practice, and suggestions for improvement. The interview guide for this round can be found in Appendix B.

3.4 Analyses

The interview data were analysed using thematic analysis. Following the semi-structured interviews, all recordings were transcribed verbatim and reviewed in full. The analysis focused on identifying recurring themes related to the experiences, challenges, and suggestions of TAs involved in group work within computer science education.

To structure the analysis, an inductive coding approach was used. First, initial open codes were assigned to segments of the transcripts based on recurring topics, phrases, and reflections that appeared meaningful in the context of the research questions. These open codes were then compared and grouped into broader categories, which captured patterns across multiple interviews. This process was iterative: themes were refined and merged where appropriate, and new themes were added as needed to reflect the data more accurately. The coding was done manually in Excel, using a spreadsheet that included the coded excerpts, assigned themes, and short notes summarizing the key points raised by each TA.

Throughout the analysis process, care was taken to remain close to the participants' own words and perspectives. Representative quotes were selected to illustrate key findings and ensure that the voices of the TAs remained central in the interpretation of the data.

4 Results

This section is divided into three parts to reflect the structure of the research process. The first part presents the insights gathered from initial interviews with TAs, identifying both the challenges they face and the obstacles students encounter in group work. The second part introduces a TA guideline developed based on those findings, offering practical strategies to support student collaboration. The third part reports on a second round of interviews, where TAs responded to the proposed guideline, evaluating its impact and feasibility.

4.1 First Round of Interviews

4.1.1 General Experience and TA Roles

This section introduces the participants and their diverse backgrounds as TAs, including their subject areas, teaching experience, and types of responsibilities. Understanding the variety of TA roles helps contextualize their perspectives on group work and collaboration challenges.

TA Experience

Six participants described a range of teaching-assistant experience. The types of courses varied widely, from introductory databases to advanced topics such as modeling, security, and experimental design. Four participants focused on programming-related content while the other two participants focused on mathematical subjects with some programming content. The table below exactly describes every participant's experience as a TA.

Table 1: TA Experience

Participant	Courses	TA Tenure (semesters)
L1	Experimental Design and Data Analysis & Introduction to Probability Statistics	1
L2	Experimental Design and Data Analysis & Introduction to Probability Statistics	2
L3	Modelling and Simulating	1
L4	Security & Concepts of Programming Languages	3
L5	Reinforcement Learning, Modern Game AI, Introduction to Video Game Making, Introduction to Programming & Databases	10
L6	Databases	1

TA Roles & Responsibilites

Three TAs described their primary responsibility as facilitating practical lab sessions, though the nature of these labs differed. For two of them, the labs functioned mainly as general Q&A sessions where students could ask questions about any aspect of the course. For the third, the labs were more focused, centering on programming assignments; student groups worked in a computer lab and could ask the TA for help with their work. Another TA worked on a course centered around a group project. Their main role involved facilitating meetings with their assigned student groups and supporting them with all aspects of the group work. This was the only TA whose primary responsibility explicitly included managing group collaboration. In addition to these tasks, all TAs were involved in grading assignments and/or exams. One TA's role focused exclusively on grading, while the last TA was highly experienced and had performed all of the roles described above. One TA explained: *"So it was the students' responsibility to ask us questions and to make sure they got the meetings planned, and they needed to make sure that the questions were sent to us in advance, so those were all their responsibilities."* The idea that students were solely responsible for taking initiative in seeking help was supported by all participants who facilitated labs or meetings.

Known Collaboration Strategies

The participants were asked what strategies they used as a student or deemed effective. Participants displayed markedly different approaches to effectively work in a group, ranging from enhancing communication channels to establishing clear role assignments and timelines. One TA argued that *"communications can solve most of them"* advocating for open dialogue and regular check-ins to surface issues early. Another TA relayed an especially interesting approach to group work where the

group would all solve the assignment separately and combine answers. The same TA recommended structured progress reviews *"check-ins on progress, making sure everybody knows where they stand"* to maintain accountability and keep groups aligned. Four TAs emphasized the importance of effectively breaking larger projects into manageable milestones. As one TA described, *"clear task distribution and clear deadlines for when individual tasks should be done"*. All of the TAs agreed that they were capable of conveying these techniques to students; however, the limited contact they currently had with students made this difficult.

4.1.2   TA Obstacles

This section outlines the main challenges TAs face in supporting students, with a focus on limited contact and low attendance.

Minimal Student-TA Contact

This obstacle poses two separate limitations for the interviewed TAs: The inability to have the chance to identify challenges students might be facing and the reluctance of students to seek the TAs help. TAs consistently reported that their role offered very limited direct engagement with students, making it difficult to identify who was struggling or in need of support. One TA noted: *"So we also couldn't be aware that much of the challenges they were facing"* , emphasizing that many students never sought out the TA in the first place. This minimal contact meant TAs often received issues only after they had escalated, rather than being able to proactively intervene. A TA showed this by saying: *If they have, like, I don't know, maybe the courage to just ask; hey what what's going on? Then it will probably be fixed quite easily but as a TA you can't really force them to ask questions"*. Another participant highlighted a possible reason for this *"They might feel peer pressure to not talk about an issue"* during practical labs.

Attendance

Most TAs noted that irregular attendance, by students in the practical labs, made it harder for them to notice and help students who were having difficulties, since they could only help those who physically showed up. As one TA explained, *"So even if you could detect that type of stuff (referencing collaboration issues) then it's probably the people who don't come"*, highlighting that absent students and their problems often remained invisible.

4.1.3   Obstacles in Group Work

This section describes the collaboration difficulties students face when working in groups, as observed by TAs. Themes include social dynamics, group formation, motivation, scheduling, uneven competence, and lack of instructional design. These insights illustrate how both social and structural factors affect group performance.

Social Issues

Participants identified social dynamics as the primary barrier to effective group work, noting that navigating diverse personalities often led to frustration and inefficiency. One TA admitted from

their own experience in group work, *"I kind of hate group work because you have to deal with multiple types of people"*, highlighting the challenge of balancing assertive, passive, and incompatible peers within a single team. Several respondents emphasized that knowing each other made it easier to work together *"But it was easier to do with a group of people that you knew to do the whole assignment"* suggesting that random assignments fueled social friction and repeatedly doing group work with the same effective group was preferred. Others described members who were *"too pushy for the project"* dominating discussions and marginalizing quieter students, which the participant called *"A quite terrible experience"*. Further complicating matters, some TAs observed that when group members failed to integrate socially, responsibility became imbalanced: *"100% ... either you're going to do all the work or none of the work"* reflecting how extreme personalities could take over all the tasks or avoid them completely. TAs also saw these issues in the courses they TA'd. As one TA noted: *"Every year we have at least three or four students that say, hey, I cannot work with others. I want to do this alone"*. A few noted that overly accommodating members could be just as problematic *"You can be a little bit too direct but you can also be a little bit too easygoing"* because if students that are too silent problems may fester unnoticed. There was only one TA who had not experienced social issues in both their own courses and the course they had TA'd.

Group Formation

In the courses the participants assisted students were asked to form groups themselves. Several TAs noted that assembling groups posed a barrier to effective collaboration. One TA commented, *"For sure, some people had a problem with finding a group to work with their own, which was not good for us, because it was more work"*, they explained, *"If the groups are random, I think that's quite annoying, very fast, if you cannot decide who you're in the group with"*. While a fast solution to students not being able to find groups on their own would be random assignments, TAs noted this could possibly lead to social issues. These difficulties often delayed project initiation and increased the burden on TAs to facilitate group formation and monitor early progress. However, not all participants experienced group formation as a major issue. One simply responded from their own experience, they only worked with peers they knew when asked about challenges finding or forming a team, suggesting a general acknowledgment rather than a serious obstacle.

Motivation

Participants highlighted that uneven effort among group members often led to demotivation and when students mentioned these issues to TAs they were required to intervene directly. One TA recalled needing *"To have a sit down with one of the [group members] to make sure that everybody spent as much effort in the project as she wanted"* illustrating how disparities in commitment could derail progress. Ensuring consistent participation was a common struggle, as TAs noted the difficulty in making sure that everybody does their things and does their work especially when some students depended on others to carry the bulk of the tasks. Furthermore, varied time investments *"If you're very dependent on other students [and they] don't want to spend as much time, that can be a little bit difficult"* spoken from their own experience. Other TAs agreed that dependence on other students and having differing time management makes coordination difficult.

Two TAs noted that problems in work division was a result of minimal student-TA contact,

identifying who did what on an assignment was especially hard for them. One TA noted: *"So I think for us it's very difficult to say who did the work, how much it was divided between people, because these reports are kind of standardized, so it's difficult to realize that"* showing that even after an assignment has been handed in it is hard to identify if there was a problem.

Instructional Design

When asked if the courses the participants TA'd had instructed students on how to collaborate on the assignment participants mostly answered in agreeance. One TA noted, *"No, I think very rarely this is discussed with students it would force them a bit to divide the task between them more (referencing a collaboration strategy)"*, indicating that teams receive little to no instructional prompt on how to allocate responsibilities. As a result, students often begin group assignments without knowing how to coordinate roles or communicate effectively, which can lead to confusion and uneven work distribution. However, only one TA remarked, *"I wouldn't necessarily say that it's a challenge most students will figure that out on their own"*, suggesting an assumption that collaborative skills emerge naturally.

Scheduling issues

Participants frequently noted that coordinating meeting times between students was a major hurdle, as one TA commented, *"Most of the time they start to work very late to try to find a time that works for the group"*, which often delayed project progress. Another TA explained that even when meetings were scheduled, *"Communication doesn't flow ... it is not really that manageable"*, emphasizing that last-minute planning made it difficult to effectively work together. TAs noted a logical problem resulting from scheduling issues might be late submissions. However, late submissions were not widespread, TAs observed that *"Only a small part of them have late submissions"* which still strained timelines when deadlines were missed. When a deadline passed without full group participation, a TA noted that there was then nothing they could do to solve it *"It's been like four weeks so no, it's just its own consequences, I suppose, so you know. It's on them"*.

Varying competence & trust

Participants frequently noted that wide variations in skill level, meaning, differing depths of subject knowledge created persistent competence gaps within groups. A participant recalled that *"The teacher tried to match people who had high competence with low competence, so groups are more that people could learn something from each other"*, but said this approach didn't fully solve the differences between students. Stronger students felt frustrated carrying weaker peers, and weaker students sometimes became overly dependent on others' expertise. These competence disparities directly undermined trust, since students were reluctant to rely on teammates whose contributions they believed would fall short. From their own experience one TA explained, *"Also know from my experience that I often didn't want to divide the task because I prefer to do everything on my own and then have kind of control over everything"* reflecting how peers worried that uneven skills would cost them higher grades. Another noted, *"I see symptoms of this because when you give someone who's weaker more responsibility, you don't know if they'll manage it"* showing the give and take of trusting group members to do work they are supposed to do. Issues in trust recently also arise when students in a group use AI. one TA observed, *"Some people just directly use generative AI*

without thinking themselves", underscoring how those who leaned heavily on AI often failed to engage critically with the material.

4.1.4   Potential Solutions

This section describes the TAs' suggestions for improving group work dynamics and support. Proposed solutions include increasing structured contact between TAs and students, providing training for TAs, redesigning assignments to include clearer collaboration guidelines, and rethinking group formation strategies. These ideas directly inform the development of the TA guideline.

More Student-TA Contact

Among all the proposed solutions, increasing contact between students and TAs was discussed most extensively. However, perspectives on the value and feasibility of this solution varied considerably. Some participants expressed optimism, suggesting that more regular or visible contact such as scheduled check-ins or a greater presence during lectures—could help students feel more supported and lower the barrier to asking questions *"I guess there's this wall that if you you're not forced to it then you don't talk to the TA by yourself and you don't mention the issues"*. Others, however, raised concerns about the practicality of implementing such contact, especially given the current limitations of the TA role and available resources *"I would say there's nothing we could do because we can only see their output, their results. We cannot see the progress or the process before the results"*. A key distinction made across interviews was between forced and voluntary contact. While some felt that encouraging natural, approachable contact would be ideal, others described structured or even mandatory interactions such as requiring students to meet with TAs at specific points in the course as more effective in making sure students took part *"People learn a lot from structure, so giving them some structure with those weekly meetings really helps"*. Finally, several interviewees pointed out that the relevance and necessity of increased contact might differ by year in the program. For instance, more structured TA support was seen as particularly helpful for first- and second-year students, who are still developing academic independence *"I think maybe it's a little more feasible for bachelor students because bachelor students are usually still forced to to attend both lectures and TA sessions"*. In contrast, other TAs judged more contact in later years would not be hurtful *"I would say it can not hurt to do it in any level, especially in the master's over the years.I've seen that because people come from all around the world, from different backgrounds, you can never assume that somebody knows something"*.

TA Education

The interviewees emphasized that adequate training is essential for TAs to effectively support student collaboration. A recurring theme was that TAs need the skills to recognize when group work is not functioning well and to intervene appropriately *"To be honest, I think it all starts with having the TAs well equipped"*. They also suggested that the entire higher education system should pay more attention to this issue, indicating a broader institutional responsibility *"it's actually a discussion in whole higher education on what what does it mean to be a good scientist?"*. At the same time, some interviewees acknowledged that training alone is not enough if TAs are not present or visible within the student group context. Simply knowing what to do is insufficient without access to the social dynamics where problems occur *"I don't know if it's a solvable task to identify*

that unless you are actually in the group and know it". Overall, there was a shared belief that TA education is a critical factor in improving collaboration outcomes, but also recognition that both training content and context of the course matter.

Instructional Design

Several interviewees noted that students may benefit from more structured guidance in group assignments. There was a shared sense that clearly defined expectations and timelines can help students manage their tasks more effectively. A participant noted, *"It would actually be good to, already have that in the structure of the assignment itself, right? Don't let people figure it out, but rather, here is the roles, distribute them"*, suggesting that the structure of the assignment itself—such as specifying group roles or providing milestone deadlines—plays a crucial role in preventing issues before they arise. TAs explained that they could reinforce this structure to students. Participants indicated that TAs could remind students of deadlines, help interpret assignment instructions, and ensure that group processes stay on track throughout the project. One interviewee emphasized that having TAs reiterate key aspects of the assignment during contact moments could enhance student understanding and reduce confusion *"Maybe having the professor restating it to give it more weight is also something that could be beneficial"*. However, a few respondents also pointed out that instructional design should not be overly rigid. While structure is beneficial, they emphasized the need for flexibility in how it is applied, particularly because students respond differently to formal pedagogical approaches. As one TA put it: *"No, because I sense that a lot of these pedagogical courses don't really stick with people."* This suggests a skepticism toward overly theoretical instruction and highlights the importance of adaptable, responsive teaching. In this context, the TA's role as a flexible intermediary—someone who can clarify and adjust the structure to fit specific group situations—was viewed as particularly valuable. In summary, the interviews show that having a clear structure is key to good group work, and that TAs can help support and strengthen this structure during the course.

Group Formation

Interviewees expressed a range of differing views regarding group formation and how differences in student competence should be handled during this process. Several participants reflected on the balance between random group formation and more intentional strategies. One suggestion was that in the early years of a program such as the first and second year more deliberate group formation could help students benefit from peers with different strengths. This aligns with the view that having a clear role distribution within a group can enhance collaboration and learning outcomes *"I imagine that the leader would be the one with the best competence.So maybe they would have more responsibility in terms of checking the final report"*. This suggestion rests on assessing students strengths and matching students with each other. However, others noted challenges with structured grouping, emphasizing that students would work better with students they are familiar with thus needing to from groups on their own. A view highly supported through interviewees was that randomized groups lead to more negative outcomes than it leads to positives *"I did a random assignment. And that was the very worst. That was the year where I had the most complaints about people not contributing and having to be removed"*.

4.2   TA Guideline

This TA guideline (Appendix C) was directly developed from the findings of the first round of interviews. As described earlier, the challenges identified by the participants were grouped into two categories: those encountered by TAs in supporting students, and those experienced by students during collaboration. Accordingly, the guideline addresses both categories through two components: structured TA–student check-in meetings during group projects, and targeted group check-ins during regular practical lab sessions. This distinction matches the kinds of challenges TAs described and the solutions they suggested. Some solutions require changes to the course setup, while others can be used without changing the structure. In this way, the guideline incorporates both structural interventions and more flexible, low-threshold strategies.

The first component addresses the problem that TAs often had limited opportunities to support students due to minimal direct contact. As many participants described, students were solely responsible for initiating interaction, and TAs were not in a position to proactively check on how group collaboration was going. This meant that issues such as uneven participation, unclear task division, or social tensions were often not visible until they had escalated. In response, the guideline recommends introducing mandatory TA–student check-in meetings during the early phase of a group project. These brief (10–15 minute) meetings should focus on open discussion of group functioning. Suggested prompts include questions about clarity of tasks, communication, workload distribution, and any early challenges. Groups are encouraged to document any goals or action points that arise. After the initial phase, these check-ins can be made optional depending on the needs of the course and students, allowing for flexibility while still supporting early structure. TAs are advised to take a facilitative rather than directive role—listening actively, normalizing common challenges, and escalating serious concerns when needed.

The second component targets a more practical context: the lack of group interaction during regular lab sessions. In the interviews, TAs noted that students often hesitate to ask for help with collaboration issues during labs, as the norm is to only seek help for technical course content. To address this, the guideline encourages TAs to proactively engage with each group during lab sessions. These brief in-class check-ins are guided by four themes derived directly from the key obstacles identified by TAs: motivation, social dynamics, communication, and competence disparities. Example questions include: "Are all group members actively contributing?", "Have there been any tensions?", "Is communication going well?", and "Does everyone feel comfortable with the material?". These moments are designed to surface problems that would otherwise remain hidden, especially for students less likely to seek help on their own. The guideline emphasizes that TAs should not be expected to solve all problems themselves but can guide students to reflect and, when necessary, refer them to instructors for further support.

Together, these two components aim to strengthen the TA's role as a supportive presence in group work not by adding significant new responsibilities, but by creating structured moments where group dynamics can be discussed early and openly.

4.3 Second Round of Interviews

4.3.1 Insights

The second round of interviews was conducted to gather feedback on the TA guideline developed after the first round. All participants recognized their own insights in the proposed guideline and expressed general agreement with its goals and structure. Nevertheless, they also offered critical reflections and suggestions to improve the guideline's effectiveness and feasibility in real teaching environments.

4.3.2 Concrete Suggestions for TA Support

Several participants highlighted the importance of making the guideline more concrete. One participant stressed that while the main themes motivation, communication, social dynamics, and competence disparities were well-chosen, the document would benefit from the inclusion of specific examples, behavioral signals, and possible interventions. This would help TAs not only recognize group collaboration issues but also feel equipped to act upon them. There was a shared belief that naming problems alone is insufficient; TAs should be trained to observe and respond to early warning signs during student interactions.

In addition, participants discussed the potential of providing TAs with a rubric or scale to assess group dynamics. Some welcomed the idea, noting it could help identify struggling groups more consistently. However, others voiced concerns about the pressure such tools might place on students, especially if assessments were too visible or perceived as judgmental. One solution proposed was to keep such tools internal to TAs and lecturers, using them as diagnostic support rather than formal assessments.

4.3.3 Impact of Structured Contact

Participants emphasized the value of structured check-in moments between TAs and student groups. These were viewed as a necessary intervention, especially for groups that are struggling but may not seek help proactively. TAs pointed out that the students who would benefit most from these meetings are often those who avoid voluntary contact. As such, making these meetings mandatory at least in the early stages of a group project was considered critical for early detection of collaboration problems. Some participants also advocated for documenting the outcomes of these check ins, so lecturers could be kept informed about group dynamics.

4.3.4 Concerns about Feasibility

Despite the strong support for the content of the guideline, concerns were raised about its practical implementation. In particular, participants noted that scheduling structured meetings with every group might be unrealistic in courses with large student numbers and limited TA capacity. The feasibility of embedding these check-ins in existing course structures was debated, the idea of treating the guideline as a flexible framework adaptable to specific course needs was generally supported.

5   Discussion

The goal of this study was to investigate the challenges and potential solutions to Computer Science student collaboration from the perspective of TAs. To this end, two rounds of semi-structured interviews were conducted with six TAs who support a variety of programming, mathematical, and project-based courses in the Computer Science curriculum. In the first round, TAs views on the perceived obstacles in group work were discussed as well as what potential solutions they were able to think of. After, the first round the TA guideline (Appendix C) was created based on this first round of interviews. During the second round of interviews the TAs discussed this guideline and expressed their views on its feasibility and potential effects. Through thematic analysis of the interview transcripts, we identified key themes aligned with our three subquestions; the challenges TAs observe in student collaboration, the potential solutions they believe could mitigate these challenges, and how they expect those solutions to impact collaboration. In the sections that follow, we discuss these findings in relation to existing literature and reflect on their practical implications for TA training and course design.

5.1   Challenges in Group Work

The first sub-question focuses on the obstacles TA see in student group work: "What challenges do TAs observe in student collaboration?" This question is answered in two parts because students themselves encounter multiple problems when working together, and TAs face their own limitations when trying to help students. Students and educators have identified four key challenges that hinder effective group work in higher education computer science, as described in chapter 2.3. These include a lack of instructional design, cultural resistance to collaboration, fragmented task division, and concerns about fairness and plagiarism. With these obstacles in mind, it is valuable to examine how TAs themselves perceive the challenges of group work in higher education computer science.

5.1.1   Obstacles faced by students in group work

TAs consistently observed that students encounter a range of recurring obstacles in group work, many of which reflect well-documented issues. These challenges are closely linked and can make each other worse, leading to poor group dynamics and weaker learning results. Through their unique position close to the students, TAs provided insights that not only reaffirm known issues but also offer a nuanced understanding of how these can manifest in practice.

A central theme that emerged is that group members often struggle to work well together on a social level. TAs reported that personality clashes and poor communication often led to frustration and disengagement. Dominant students could overshadow quieter peers, while overly accommodating students risked being sidelined. While existing relationships between students sometimes helped facilitate smoother collaboration, they could also reinforce social exclusivity and limit opportunities to learn from new peers. These observations confirm that social cohesion and interpersonal compatibility are crucial for effective teamwork, yet they are often overlooked in course design [AKPG25].

Closely related is the issue of uneven participation, which TAs identified as a major barrier to fair collaboration. Students differed significantly in their motivation and willingness to contribute,

leading to resentment among group members and, in some cases, complete disengagement by underperforming individuals. TAs noted that high-performing students often felt burdened by having to compensate for peers, which over time reduced their own motivation. This imbalance, while commonly reported in group work literature, is rarely visible to teaching staff unless explicitly raised by students [Syn16]. TAs, however, are often in a better position to observe these patterns—if sufficient contact exists.

Another recurring obstacle is the lack of intentional instructional design in group assignments. According to the TAs, students were frequently asked to work together without being given adequate guidance on how to do so. Instructions on dividing roles, coordinating work, or managing group processes were either missing or vague. As a result, students started group projects with little clarity on expectations, often leading to confusion, inefficient planning, and uneven workload distribution. This reflects broader critiques in the literature, which emphasize that collaboration does not automatically lead to learning unless it is carefully scaffolded [SSH23], [LB11]. Interestingly, TAs echoed this concern from the student perspective, noting that they are unable to reinforce collaborative structures when those structures are not built into the course design.

Finally, differences in competence levels were described as a persistent source of tension. In mixed-ability groups, higher-skilled students were often reluctant to delegate tasks, fearing their grade would suffer, while lower-skilled students tended to become passive or overly dependent. This imbalance undermined mutual trust and created a situation where collaboration became more about damage control than shared learning. TAs noted that while some instructors attempt to balance groups based on skill, this strategy does not always prevent negative dynamics from forming.

Taken together, these obstacles illustrate how group work is not just a matter of putting students together—it is a complex social and pedagogical process that requires deliberate structure, monitoring, and support. The TA perspective adds value here by highlighting not only what goes wrong, but when and how these issues typically surface. Unlike course instructors, TAs often engage more informally with students and are therefore better positioned to notice emerging problems. However, their capacity to intervene remains limited without systematic opportunities to interact with student groups and address these challenges early.

5.1.2 Limitations in TA Support

This next section describes the two limitations TAs observed in helping students with their group work, applying to courses where mandatory meetings with TAs are not implemented.

While TAs are often in a strong position to observe group dynamics up close, their ability to support collaboration is limited by structural factors in the courses they assist with. Two key obstacles emerged from the interviews: minimal student-TA contact and inconsistent attendance. Together, these issues create a situation in which TAs are expected to support collaboration, but lack the means to do so effectively.

A central limitation highlighted by nearly all participants was the lack of direct and consistent contact with students. In most courses, students are responsible for initiating interactions with TAs—whether during lab sessions or scheduled meetings. As a result, many TAs reported

that they often only became aware of collaboration issues after problems had escalated. This reactive model made it difficult to identify early signs of conflict, uneven contribution, or disengagement. One TA noted that unless students have the courage to just ask, issues often go unnoticed. This reflects broader concerns in the literature about the visibility of individual contributions in group projects, which instructors often cannot assess unless problems are explicitly reported [LeJ06].

Irregular attendance further limited the effectiveness of TAs in their support role. Several participants observed that the students most in need of help were often the ones who did not attend practical sessions regularly—either due to scheduling conflicts, lack of motivation, or group disengagement. As one TA put it, "even if you could detect issues, it's probably the people who don't come." Without consistent engagement, opportunities for informal check-ins and early intervention were severely reduced. These missed connections not only affected struggling students but also limited the TAs' ability to get a full picture of group dynamics.

Importantly, these structural constraints are not within the TAs' control. As some participants noted, they are often asked to support teamwork without being given the tools or authority to intervene effectively. While they may recognize signs of imbalance or disengagement, their role is largely passive unless course design includes structured moments for interaction.

These findings suggest that while TAs are well-positioned to notice collaboration challenges, their ability to act depends heavily on the design of the course and the expectations placed on them. Without regular, structured contact points or clear guidance on how to support collaboration, TAs are left with limited opportunities to make a meaningful impact despite their willingness to help.

5.2 Potential Solutions

This subsection addresses the second sub-question of the thesis: "What potential solutions do TAs believe could mitigate these challenges?" Describing, the main strategies TAs suggested for overcoming the limitations they face and the challenges students encounter during collaboration. The most emphasized solutions identified by TAs were increased student-TA contact, improved instructional design, clearer group formation strategies, and more structured monitoring of student collaboration.

5.2.1 More student-TA contact

Across all interviews, increasing student–TA contact emerged as the most frequently mentioned and widely supported solution. TAs strongly felt that more regular and structured interaction would allow them to play a more proactive role in supporting group work. In current setups, where students are expected to take full responsibility for initiating contact, TAs often become involved too late, only after group problems have already escalated. Scheduled check-ins or low-threshold contact moments were viewed as crucial for surfacing issues early and making TA support more accessible.

This suggestion directly addresses two key challenges identified in the previous section: minimal student–TA contact and attendance. TAs emphasized that more frequent and visible interaction

could lower the threshold for students to raise concerns, especially in cases where social dynamics or group imbalances make it hard to speak up. For example, mandatory check-ins would give quieter or struggling students a structured opportunity to share collaboration issues, rather than relying on them to approach the TA independently.

This aligns with existing research showing that structured support mechanisms such as progress meetings or guided reflection points—can help surface hidden group issues, support accountability, and improve group functioning overall [LB11]. However, it also criticizes the time and effort faculty would have to spend making these meetings possible.

In short, more structured student–TA contact is a promising and widely supported strategy, but its impact depends heavily on how it is implemented. When integrated into the course structure and combined with realistic expectations and appropriate training, it could significantly improve the ability of TAs to support student collaboration. Yet it also raises important questions about resources, workload, and the limits of TA responsibility especially in larger courses where personal contact is already difficult to maintain.

5.2.2 TA Education

Another solution highly suggested by the participants was the need for better preparation and guidance for TAs when it comes to supporting group work. Many felt under-equipped to respond to issues such as uneven participation, social conflict, or competence mismatches despite being the most accessible point of contact for students during practical sessions. While most TAs have technical expertise, as they have passed the course they are now teaching, few had received any training related to group facilitation or collaboration.

This gap in preparation is significant, especially given the types of challenges TAs are exposed to. For instance, being able to recognize social loafing or mediate group tensions requires a different skill set than providing technical feedback. If TAs are expected to support student collaboration effectively, they need concrete tools for doing so—such as strategies for identifying when group dynamics are becoming dysfunctional, or how to prompt students to reflect on roles and contributions. Prior research has emphasized that peer educators and TAs can play a critical role in shaping group outcomes, but only when they are given appropriate pedagogical training [ZCPW25].

Several TAs mentioned they would have welcomed more explicit guidance during their own onboarding, particularly around how to intervene when group processes broke down. However, this also raises a broader question about the scope of the TA role. In many institutions, TAs are hired primarily for technical or grading tasks, not for educational mentoring or group facilitation. Expanding their role to include social and pedagogical support would require not only extra training but also changes in institutional expectations and workload models. Without structural support such as dedicated time for training or recognition of these responsibilities it is unlikely that meaningful change can occur.

Moreover, even if training were implemented, there are limits to what TAs can realistically achieve within the current course setups. If courses lack clear collaborative structures or formalized group

processes, TAs are left trying to fix problems reactively, rather than supporting students proactively. As suggested earlier, TA education must go hand-in-hand with thoughtful course design. Without both, the burden of solving group issues may fall unfairly on individual TAs, who are often working under time constraints and without formal authority.

In sum, improving TA education around collaboration could significantly enhance student support during group work but only if implemented alongside structural changes in how courses are designed and how the TA role is defined. TAs are well positioned to help students develop collaboration skills, but they must be equipped with the knowledge, resources, and institutional backing to do so effectively.

5.2.3   Instructional design & Group formation

The final two solutions raised by TAs—improving the instructional design of group assignments and being more intentional about group formation address deeper structural issues within group work. TAs noted that many group projects suffer from vague expectations, unclear roles, and a lack of embedded reflection or feedback moments. These design flaws not only leave students confused about how to work together but also make it difficult for TAs to intervene when problems arise. As discussed earlier, students often divide work in ways that reduce actual collaboration [vdMA21], and without guidance or checkpoints, they may never reflect on how their group is functioning.

In addition to structure, TAs pointed to the role of group composition in shaping team success. While some favored random assignment to ensure fairness, others noted that large gaps in motivation or competence between students could destabilize the group dynamic. This mirrors debates in the literature: randomized groups may reduce bias or social exclusion, but instructor-formed or student-selected groups may result in better short-term cohesion or performance, depending on the context [ACTF+11]. However, most TAs agreed that the current practice; leaving group formation to students or assigning randomly without considering skill or personality—often leads to dysfunctional teams. They felt that more deliberate group formation, even if based on just one factor (e.g., prior experience), could help avoid extreme imbalances.

Still, both better course design and more thoughtful group formation take extra time and planning from instructors, who often already have full schedules. TAs understood this, but they believed that even small changes—like adding check-in moments, encouraging role rotation, or spotting risky group setups—could already help. They also stressed that group work should be built into the course from the start, not added as an afterthought. If this doesn't happen, TAs are left to deal with group problems without enough support, and students miss the chance to really learn how to work together.

5.3   Viewed impact of the TA Guideline

This subsection addresses the third and final sub-question of the thesis: "How do TAs view the impact of the potential solutions on collaboration?" Based on the insights gathered, TAs expressed generally positive expectations regarding the influence of the proposed TA guideline. Their insights in the first round of interviews served as the foundation for the development of the TA Guideline.

This guideline brings together the most relevant suggestions in a practical format, including recommendations for improving contact moments with students, attention to uneven participation, identification strategies for social and motivational problems and a more supportive role for TAs.

A key outcome of this study is the TA Guideline, developed directly from the practical insights and reflections of the participants. While the suggestions from TAs varied, there was considerable agreement on several core strategies. The guideline describes these into a series of concrete actions that TAs can apply in practice. These include, for instance, structured check-in moments early in the assignement, simple prompts for observing group dynamics, and suggestions on how to approach students who may be struggling with group work. Most TAs indicated that such a guideline would be helpful, particularly for less experienced TAs. They appreciated that it offers structure without being overly prescriptive. TAs emphasized that having practical tools and examples would make them feel more prepared and confident when guiding students, especially in recognizing and addressing early signs of collaboration problems. In this way, the guideline not only responds to the challenges students face, but also addresses the limitations TAs themselves experience in their role.

In reflecting on the potential solutions more broadly, TAs believed that even small interventions could have a meaningful impact on group dynamics. The most frequently mentioned solution—more structured student-TA contact—was seen as the clearest opportunity for improving collaboration. TAs believed that regular check-ins would help build trust and create space for students to share concerns early, before problems escalate. They also felt that these moments would give TAs better insight into group functioning, allowing for more targeted support. Similarly, clearer instructional design was expected to reduce confusion and make it easier for students to work together productively from the start. The same applied to group formation: while TAs understood that it may not always be feasible to let students choose their own groups, they believed that greater transparency about the formation process and criteria could improve group dynamics and reduce feelings of unfairness or randomness. Finally, participants felt that basic training or orientation sessions with this guideline for TAs would make a difference in how effectively they could support collaboration.

Across these reflections, it became clear that TAs see themselves as willing and capable supporters of student collaboration, but that they currently operate with limited tools, time, and clarity. The solutions they proposed were not complex or unrealistic; instead, they focused on practical and achievable adjustments that could be integrated into existing course structures. TAs were realistic about the constraints of their role but hopeful that small structural changes—like clearer expectations, brief training, and more regular contact moments—could significantly improve the group work experience for students.

6 Conclusions

6.1 Limitations of the study

This study provides useful insights into how TAs experience their role in supporting student collaboration, but there are some limitations to keep in mind. The goal of the research was not to draw broad conclusions that apply to all TAs, but rather to explore in detail how a small group of

TAs experienced their work in a specific setting. For this reason, a small group of six TAs from similar academic departments was chosen. The focus was on getting in-depth, context-specific information instead of results that could be applied more generally.

All of the TAs who took part were open to sharing their views and seemed motivated to help students work together more effectively. However, this does not mean that all TAs think the same way or face the same kinds of challenges. The study may not have included voices of TAs who are less interested in collaboration or who face other types of difficulties. Additionally, because the interviews were guided by a predetermined topic list and limited in duration, not every topic could be fully explored. It is therefore possible that other TAs may have had relevant experiences or perspectives on these themes but did not mention them due to time constraints or a different focus during the interviews.

6.2 Further Research

This study provides insight into how TAs experience and reflect on supporting group work. Since collaboration plays an increasingly important role in education and TA involvement can strongly affect group dynamics, more research is needed to build on these findings and explore new questions that have emerged.

First, future studies could follow how the role of TAs in group work develops over time. As more attention is given to group work in university courses, it would be useful to explore whether and how TA responsibilities and approaches change in the coming years. This could include tracking whether structural changes, such as the introduction of guidelines or check-ins, lead to more consistent support and better group outcomes. Second, future research could explore differences between departments or faculties. The current study was limited to TAs from similar educational programs. A broader study might reveal how TA roles differ in other disciplines, and whether some of the proposed solutions work better in certain contexts than others.

By focusing on these areas in future research, universities and educators can learn more about how to support both TAs and students in making group work more effective and enjoyable. This could help improve course design and lead to better learning experiences for students.

6.3 Concluding Remarks

This study examined the challenges that TAs encounter when supporting student collaboration in computer science education, as well as the solutions they consider promising. Based on two rounds of interviews, it became clear that TAs observe both structural and content-related issues in group work. Students often receive limited guidance on how to collaborate effectively, while TAs face constraints in offering support. These findings informed the development of a guideline focused on low-threshold, feasible adjustments to course design.

The results show that TAs provide valuable insights into student group functioning and that their experiences can contribute to improving instructional design. Involving their perspective enables course coordinators to address collaboration more deliberately as a learning objective. The

guideline offers practical tools to support this process.

Further research is needed to evaluate the broader implementation and effectiveness of such guidelines. However, this study demonstrates that TAs can play a meaningful role in improving collaboration in higher education computer science, provided they are better supported and actively involved.

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A   Interview Guide 1

Introduction

- Welcome the TAs and introduce yourself (name, role in research).

- Explain the purpose of the interview: exploring TA perspectives on student collaboration, focusing on challenges and potential solutions.

- Emphasize confidentiality: responses will be anonymized; no personal information will be shared publicly.

- Request permission to record the conversation.

- Check if interviewees have any questions before starting.

General Experience as a TA with Student Collaboration

- Can you tell me about your general experience as a TA?

  - If unclear, ask more specific questions, such as how long they have been a TA, what types of courses they have worked on, etc.

- Can you describe your general role and responsibilities as a TA regarding student collaboration?

  - If unclear, prompt with examples such as facilitating group sessions, grading teamwork-based assignments, guiding discussions, etc.

Identifying Challenges in Student Collaboration

- As a student, how have you experienced group work within your computer science courses?

- Follow-up: Have you seen students have the same experiences as a TA?

- What would be the main challenges you have seen students experience during your time as a TA?

- What aspects of group work do you see working effectively in your respective TA courses?

Possible follow-ups to explore further challenges:

- Have you noticed unequal participation among students? How does this impact group dynamics?

- Can you share any observations regarding competence disparities within groups?

- How often do scheduling conflicts affect group collaboration?

- Have you noticed a lack of structure or clear guidance impacting collaboration?

- Can you describe any communication issues you've observed among student groups?

- Do concerns about plagiarism ever affect students' willingness to collaborate openly?

- Have you encountered social conflicts (e.g., personality clashes, differing work ethics) in student teams?

Potential Solutions

- Do you know of any strategies to effectively collaborate?

- Follow-ups:

    - Have you implemented these yourself?
    - Have you seen students in your TA courses implement these strategies?

Once a list of challenges and known strategies was established, the group was encouraged to connect specific strategies to specific challenges. Afterwards, the discussion focused on identifying how TAs could contribute to addressing these issues.
Follow-up prompts:

- Looking at our list of challenges, what would be an effective strategy to mitigate this?

- How can TAs play a role in mitigating these challenges?

- Does the main professor need to teach these strategies and have them supported by TAs?

- Do TAs need to be taught how to identify the challenges students are facing?

Concluding Remarks

- Thank the TAs for their participation and valuable insights.

- Inform them about the next steps in the research process.

- Ask if they have any final comments or questions.

B Interview Guide 2

Introduction

- Welcome the TAs.

- Explain the purpose of the interview: evaluating the insights from the previous interview and collecting feedback on the proposed guideline(s).

- Remind participants of confidentiality: responses will be anonymized; no personal information will be shared.

- Request permission to record the conversation.

- Check if participants have any questions before beginning.

Review of General Insights

The general insights from Interview 1 were prepared in advance and displayed for participants during the session.
Guiding questions:

- Can you find yourselves in the insights shown before you?

- Do you feel any insights are missing based on the first interview?

- Do you feel particularly strongly about any of the insights?

Evaluation of Guideline(s)

Guiding questions:

- If these structured guideline(s) were to be used by TAs, how do you think they might impact student collaboration?

- What do you believe is necessary to implement these guideline(s) successfully?

Concluding Remarks

- Thank the TAs for their participation and valuable contributions.

- Inform them about the next steps in the research process.

- Ask if they have any final comments or questions.

C TA Guideline

C.1 Supporting Group Work

As a TA, you may be involved in courses that contain group assignments. This introduces specific dynamics and potential challenges, such as uneven participation, social friction, or unclear task division. You should start with gathering all the information on the group assignment. It is important to know if students have already been guided so you can support that. Below are two suggestions—one for course design and one for TA conduct during exercise classes—to help address these issues effectively. These two suggestions can be applied independently or together, depending on what best supports the specific needs of the course and students.

C.2 Course Design Advice: Structured TA Meeting Points

When a course includes a long-term group assignment, we recommend scheduling mandatory TA-student check-in moments during the early phases of the project. These meetings can then become optional as the project progresses. This allows for:

- Early detection of group issues such as low motivation, unclear task division, or social dynamics.

- Clear communication of expectations.

- TA visibility and accountability.

Such meetings can take place during regular exercise classes or be scheduled separately. This structure is especially helpful for Bachelor students or courses with first-time group work.

C.2.1 Practical Guidelines for TA-Student Meetings

To ensure these check-ins are effective, we recommend the following approach:

Primary Goal: The main purpose of these meetings is to assess group functioning early on and provide timely guidance. This includes surfacing issues such as uneven task division, lack of clarity on deadlines, or interpersonal tensions.

Structure of the Meeting:

- **Duration:** 10–15 minutes per group.

- **Format:** Begin with an open question such as *"How is the collaboration going so far?"*, followed by specific prompts:

    - Is everyone clear on their tasks and deadlines?
    - Are there any challenges or concerns so far?
    - How is the communication within the group?

- **Documentation:** Encourage each group to briefly note their goals and any action points discussed.

TA's Role:

- Facilitate rather than direct—allow students to voice issues.

- Actively listen and normalize struggles, especially in early group work.

- Offer suggestions or escalate problems if necessary (e.g., if a group member is disengaged).

C.3   In-Class Practice: Targeted Group Assignment Check-ins

In addition to answering questions about lecture materials during exercise classes, you are encouraged to reserve a dedicated moment during class to ask each group about their progress on the group assignment. These moments are not meant to replace your core task of helping with the course material but to complement them and enhance your role as a supportive presence during group work. These check-ins should be brief and guided by the following key themes.

- **Motivation**

  - *E.g., Are all group members actively contributing? Do you feel the workload is evenly distributed?*

- **Social Dynamics**

  - *E.g., Is everyone matching with each other? Have there been any tensions or difficulties?*

- **Communication**

  - *E.g., How is communication within the group? Is everyone able to share their ideas?*

- **Competence Disparities**

  - *E.g., Are you comfortable with the skills and knowledge levels in your group? Is everyone able to follow and contribute?*

By proactively engaging students, you create space for problems to surface early, which may otherwise remain hidden. Keep in mind:

- Not all students will seek help on their own. Your initiative is essential.

- You can refer students to the lecturer for serious or persistent issues.

- Encourage groups to share their own solutions when possible, rather than solving the issues for them.