



## Interactions with Peers on the Path to Math Success

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**Abstract:** A key strategy to being successful in math is help-seeking. Much research has focused on how students seek help from teachers, but students also benefit from peer assistance. We analyzed conversations from eight focus groups related to students' paths to success in math. We found that students frequently brought up peer interactions as critical to their success. Three emergent themes were: support versus comparison, balance of effort within study groups, and friends versus peers. Our findings qualitatively extend current research by highlighting key ideas that impact peer interactions, such as increased reluctance to seek help in larger classes. Our findings have implications for classroom and group structures, including encouraging peer help-seeking and help-giving, as well as addressing belonging and sense of community.

### Introduction and background

As students learn, they may face challenges that require assistance to overcome. However, in the face of adversity, students do not always seek help, which can inhibit their academic achievement. In school environments, students are shaped by their interactions with peers. With more detailed accounts of how peer interactions can aid or harm students' paths to math success, educators can orient their classrooms to set students up for math achievement, potentially through peer interactions and collaboration. While the current literature focuses on quantitative patterns, this study seeks to learn more about how students describe their lived experiences.

Seeking help when navigating obstacles to learning is a key self-regulated learning skill (Karabenik, 2011). Although students tend to focus on teachers for learning support, using peers as a resource has additional benefits. Access to multiple explanations (i.e., beyond that of the teacher or text) of mathematical concepts can help students experience new perspectives (Tripathi, 2008). Moreover, helping others and seeing peers model success can increase self-efficacy and ownership in learning (Walker et al., 2010). Help-seeking from peers can also increase socialization, an important developmental skill for younger students (Newman, 2000).

Despite the benefits, some students still avoid seeking help for many reasons. For some, the likelihood of seeking help is negatively related to the perception of subsequent psychological risks (Peeters et al., 2020). These can include embarrassment in admitting confusion or errors (Karabenik, 2011), fear of frustrating the teacher or slowing down the class (Peeters et al., 2020), indebtedness to the help-givers (Karabenik, 2011), and negative social comparison to other more-capable peers (Newman & Schwager, 1993). Additionally, if students lack confidence in their peers' (or even the teacher's) ability to understand their confusion and provide adequate help, they will likely not seek help (Newman, 2000; Peeters et al., 2020).

Students' help-seeking behaviors and peer interactions are also related to their academic achievement goals (Roussel et al., 2011; Shim & Finch, 2014). Compared to students focused on demonstrating competence in relation to the task itself or their own previous competence (mastery goals), students focused on demonstrating competence in relation to others (performance goals) are less likely to engage in productive help-seeking behaviors or see peers as instructional and emotional supports (Shim & Finch, 2014). Naturally, when students focus on their own learning and improvement, rather than in relation to others, they are less likely to fear social comparison (Roussel et al., 2011) or engage in competitive, maladaptive behaviors' (Newman & Schwager, 1993).

Most studies on peers as a resource are quantitative, focusing on identifying variables that impact help-seeking behavior and learning (e.g., Roussel et al., 2011). More research is needed to understand how students think about interactions during peer support and how these can help them overcome challenges while learning math. Therefore, in this qualitative study, our research question is: *How do students describe interactions with peers on their paths to math success?*

### Methods

We conducted focus groups twice weekly for four weeks ( $n = 8$ ) to learn more about students' experiences while learning math. We posed pre-scripted questions to the students in these structured sessions, which were held online

virtually due to the COVID-19 pandemic. Our recruitment targeted identity-based affinity groups at nearby colleges, from whom we recruited current undergraduates, graduate students, or recent graduates. The participants ( $n = 25$ ) were students from universities mainly in the northeastern United States and one student who attended a university in the southeastern United States. Results from an optional demographic survey show a diverse group of participants for both race (12% Asian, 20% Black, 16% Latinx, 4% White, 2% Multi-race, 1% Other, 36% Unspecified) and gender identity (20% Male, 40% Female, 4% Genderqueer, 36% Unspecified).

This study is part of a larger project aimed at understanding student experiences in overcoming challenges to achieve math success. In each focus group, we asked students to describe past challenges during math learning, the effects on their sense of belonging, overcoming these challenges, facing new challenges, and advice for others. Although participants were not explicitly asked about their peers, we found that peer interactions was an emergent theme, particularly when participants were asked about their experiences, resources, and belonging. The codes we used to describe these interactions were peer relationships, peers as a resource, and belonging among peers.

We developed a codebook to capture students' experiences and challenges based on their discussions in the focus groups. This codebook used deductive codes based on the current literature and inductive codes that emerged throughout our research process. We coded for students' experiences with support and resources, identity and belonging, and persistence. Each focus group transcript was double-coded, and researchers met to reconcile any differences. The overall interrater reliability was over 80% and 100% once reconciled. For each segment of the focus group transcripts with a peer-related code, we identified the student's description of their experience and added an analytic memo regarding the key idea that the student discussed. After completing this for every mention of peer interaction, we derived three common themes. Students described (1) themselves as supported by or in comparison to their peers, (2) the need for balance of effort within study groups, and (3) describing other students as "friends" vs. "peers." We then chose representative excerpts for each of these themes to illustrate how the students (using pseudonyms) articulated their experiences with peers.

## Results

The students' descriptions of interactions with peers included asking for instructional help, seeking emotional support, and working in study groups. We found three emergent themes related to how students described their peers and peer interactions as they discussed their paths to success in math.

### Support versus comparison

Many students noted the benefits of getting peer help, specifically the positives of studying in small groups. For example, Sunny (Black, genderqueer) noted that "developing a more group style of working helped a lot," adding how they initially worked alone in college and would go to office hours for help. In later years, however, they "learned how to work with [their] classmates and set up study sessions sometime in the evening. Then if [their group] couldn't get it on [their] own, then [the group] would go to TA office hours together." Lucia (Latina, female) expanded this idea by also recommending a friend group "that's supportive of you and understands how you're feeling and knows that everyone struggles with something and math may be the thing you're struggling with." Eliza (no demographic data) also discussed the importance of having "more knowledgeable peers" (Newman, 2000, p. 352) in the study group: "there was usually one person that understood everything the professor said the most, so [the group] would just make him or her the teacher in a sense, and it was a smaller class. It was like five people." Zora (Black, female) added that even when no one in the group understood the instructor, there was a sense of community in the confusion that helped prevent feelings of isolation.

Conversely, some students describe peers more as a unit by which to compare their understanding and performance. This could be seen in Mario's (Latino, male) description of his struggles in a college math course, stating, "[my peers] had an idea of what was going on and I didn't. Even when we got together in groups to study and whatnot, I was the one that was making the really dumb questions." He later admitted that he thought that he was so far behind that the professor and classmates would think less of him because he "wasn't at their level." In his case, the support given by his study group was overshadowed by the insecurities he felt when he compared himself to his classmates. Interestingly, Eliza also noted a similar comparison in extracurricular activities, discussing how they joined an engineering club in which they were "scared to ask questions to [other club members]." Eliza ultimately left the club due to overwhelming feelings of discomfort and questioning their self-worth. Eliza went on to describe finding an identity-based organization for Latinx students, noting that many of these members also questioned their daily worth. Through this organization, Eliza learned about imposter syndrome and found a sense of community: "These are my people. This is where I need to latch on and just trust

that we'll all make it through together. It did challenge me, but then I also was able to find my niche." Eliza's example demonstrates the importance of a sense of belonging and community within a peer group.

### Balance of effort within study groups

Several students discussed the importance of balance with regards to effort within peer study groups. Lucia stated that she would "spread [her] asks around" to avoid "burdening any one person" and that this strategy would increase everyone's willingness to help. Ryder (no demographic data) discussed the reciprocity of asking help from and giving help to peers: "I get very worried about being parasitic, but it felt a lot more mutual, so it was nicer in the long run." Eliza discussed group members taking turns going to office hours. When personally confused about the content, Eliza would always volunteer to go from the group. These students' statements imply an attentiveness to group functioning and highlight a key give-and-take mechanism for productive study groups.

### Friends versus peers

As seen throughout the previous examples, there was a clear divide in how students referred to those from whom they sought help. Some referred to them warmly as "friends." Lucia stated, "I know a lot of my friends have been really understanding. I've definitely broke down crying about stupid math problems before to multiple of them, and they've all been really understanding, and they're just really reassuring." Others, as seen in the comparison examples above, referred to them as peers, implying a detachment or weak relationship with them. We had two graduate students discuss a possible explanation for these differences: class or cohort size. Eliza stated that issues with belonging in their undergraduate program were related to the "size of the group or the class." Eliza elaborated to describe how the uncomfortable feeling in one large class: "If you ask a question, it spooks you out a bit because you have 300 faces looking at you wherever you're at." Ryder expanded this idea by describing the differences between their master's and undergraduate programs. The master's program was "pretty small" with around 14 full-time students, which allowed students to "[get] to know each other really well." Ryder added, "It was easier to ask people I knew because with the high student-teacher ratio in undergrad, it just really meant that I still didn't know any of my classmates for whatever reason, whether I felt like I belonged or not." Ryder also explicitly stated, "grad school math definitely went a lot better because I did ask for help from somebody."

### Discussion and conclusion

In this study, we qualitatively analyzed students' descriptions of interactions with their peers in their path to math success. To date, most research on this topic has been quantitative, focusing on factors influencing peer help-seeking such as the perception of psychological risks and negative social comparison. Our study confirms many of these findings but benefits from an in-depth qualitative analysis to further explain and expand the current literature. For example, we had descriptions of insecurities and low self-worth, resulting from social comparisons, that interfered with peer help-seeking. We also saw expressions of a spectrum of achievement goals from performance-oriented (e.g., Mario comparing his performance to his classmates') to mastery-oriented goals (e.g., Lucia working with peers to gain a better understanding of the content).

We also had findings that extend the literature. First, our findings related to belonging and community were connected to a new important consideration for peer help-seeking: class or cohort size. The graduate students in the study were able to provide a clear comparison between large undergraduate and smaller master's class sizes, demonstrating the difference in their ability to know and connect to their peers. Next, we found that students discussed the balance of effort in small peer groups and how knowledge and tasks can be distributed among group members. Interestingly, even when no one in the group understood the content or task, there was still a need for non-content support (e.g., validation). This extends the current literature on help-seeking by connecting to research on socioemotional regulation strategies (c.f., Lobczowski et al., in press). These findings highlight the importance of a sense of belonging among peers, as well as building a community, especially among small groups.

### Implications, limitations, and future directions

Our study has implications for both research and practice. First, it highlights the importance of setting group norms related to balancing effort. Similarly, students should not only be encouraged to seek help when needed but also volunteer assistance when applicable. This will help create a culture of peer support in the classroom. Instructors of large classes also need to find ways for students to interact and get to know one another. For example, students could participate in partner discussions during class or collaborate on group projects. Each of these ideas can help increase a sense of belonging and community with the classroom and small peer groups.

Although we had a limited sample of participants ( $n = 25$ ) in our focus groups, this allowed us to hear more from each participant and dive deeper into their experiences. In the future, our findings could be used to create a survey to reach a broader audience. Despite our efforts to recruit participants from a variety of universities, our pool represented a smaller group of institutions. However, the participants comprised a diverse group of majors and disciplines. Going forward, we will seek out participants from institutions varying in size, both large and small. During the focus groups, we did not explicitly ask participants about their peer interactions, yet it was mentioned in all but one focus group and emerged as an overall theme. In future research, we would like to ask participants directly about their experiences with their peers.

## References

- Karabenick, S. A. (2011). Methodological and assessment issues in research on help seeking. In B. Zimmerman & D. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 267-281). Routledge.
- Lobczowski, N. G., Lyons, K., Greene, J. A., & McLaughlin, J. E. (in press). Socioemotional regulation strategies in a project-based learning environment. *Contemporary Educational Psychology*.
- Newman, R. S. (2000). Social influences on the development of children's adaptive help seeking: The role of parents, teachers, and peers. *Developmental Review, 20*(3), 350-404.
- Newman, R. S., & Schwager, M. T. (1993). Students' perceptions of the teacher and classmates in relation to reported help seeking in math class. *The Elementary School Journal, 94*(1), 3-17.
- Peeters, A., Robinson, V., & Rubie-Davies, C. (2020). Theories in use that explain adolescent help seeking and avoidance in mathematics. *Journal of Educational Psychology, 112*(3), 533.
- Roussel, P., Elliot, A. J., & Feltman, R. (2011). The influence of achievement goals and social goals on help-seeking from peers in an academic context. *Learning and Instruction, 21*(3), 394-402.
- Shim, S. S., & Finch, W. H. (2014). Academic and social achievement goals and early adolescents' adjustment: A latent class approach. *Learning and Individual Differences, 30*, 98-105.
- Tripathi, P. N. (2008). Developing mathematical understanding through multiple representations. *Mathematics Teaching in the middle school, 13*(8), 438-445.
- Walker, E., Walker, S., Rummel, N., & Koedinger, K. R. (2010). Using problem-solving context to assess help quality in computer-mediated peer tutoring. In *International Conference on Intelligent Tutoring Systems* (pp. 145-155). Springer.

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