Do Rotating Small-Group Discussions Foster Academic Help-Seeking Networks in Higher Education Classrooms?

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Abstract

This study examined whether repeated rotating small-group discussions were associated with changes in academic help-seeking networks in higher education classrooms. Participants were 129 undergraduate students from two cohorts of a teacher-education course taught by the same instructor across two academic years. Students participated in four small-group discussions in which group composition varied across activities, allowing them to interact with different classmates. Academic help-seeking networks were assessed at the beginning (week 2) and middle (week 9) of the semester using roster-based peer nominations. Social network analysis was used to examine both respondent-level nomination breadth and whole-network structure. In both cohorts, students who completed the survey nominated more classmates on average at mid-semester, suggesting a broader recognition of peers as potential sources of academic support. Whole-network patterns, however, differed across cohorts. Cohort 1 showed increases in directed ties and network density, whereas Cohort 2 showed decreases in these indicators despite increased respondent-level nomination breadth. The latter pattern occurred alongside a substantial decline in survey response rate, highlighting the sensitivity of whole-network measures to response patterns. The findings suggest that rotating small-group discussions may expand students' perceived peer academic resources, while also demonstrating the importance of interpreting network-level indicators alongside respondent-level measures and response rates.

Keywords: academic help-seeking, rotating small-group discussions, social network analysis, peer academic support, higher education

1. Introduction

As higher education has increasingly emphasized learning outcomes, educational quality, and student success, creating learning environments that foster student engagement has become a central concern (Kuh, 2009). Peer relationships are an important component of such learning environments, and they can make potential sources of academic support more visible and accessible to students. As MacGregor (2000) noted, students value opportunities to engage with their peers in meaningful academic activities, and these opportunities can help them become more connected to university life. Similarly, Wentzel and Watkins (2002) suggested that peer relationships can serve as important academic resources by helping students access information, clarify misunderstandings, receive encouragement, and participate in cooperative learning. These forms of peer support may shape students' motivation and engagement by influencing how they experience the classroom as a learning environment. From this perspective, students' engagement in learning is not determined solely by individual motivation; it is also shaped by the social context of the classroom, which can either facilitate or hinder their engagement (Lujan & DiCarlo, 2017).

Classrooms can therefore be viewed as relational learning environments in which students' engagement and access to academic support are shaped by the peer connections available to them (Cappella et al., 2013). Social network research finds that educational contexts influence the structure of students' peer relationships, including the formation of friendship and support networks (Moody, 2001). When peer relationships are weak, fragmented, or difficult to access, students may have fewer relational pathways for exchanging academic information, or participating fully in learning activities (Oumelaid et al., 2026). Thus, understanding how academic support relationships develop within classrooms is important not only for describing student interaction but also for identifying how learning environments may provide or constrain access to peer-based academic resources.

Social network analysis (SNA) provides a useful approach for examining these relational patterns. Recent studies have used SNA to investigate students' peer relationships, classroom interactions, belonging, and engagement across educational settings (Freire et al., 2024; Williams et al., 2019). By representing students as nodes and their social, academic, or collaborative relationships as edges, SNA can reveal classroom cohesion, peer clustering, central students, bridging roles, and the distribution of learning resources and social capital within a classroom (Oumelaid et al., 2026; Zwolak et al., 2017). This network perspective is particularly relevant to students' academic learning because students need not only access to formal instructional resources, but also knowledge of whom they can approach for answers, guidance, and support when they encounter academic questions or difficulties (Lujan & DiCarlo, 2017). Therefore, examining academic help-seeking within the classroom through SNA makes it possible to investigate how broadly potential sources of peer support are recognized and how these nominations are distributed across the classroom.

Despite the importance of peer interaction, academic relationships among students in higher education do not necessarily develop simply because students attend the same class. MacGregor (2000) noted that college classrooms may provide limited opportunities for meaningful connection; this means that students may attend class together but interact only briefly. As a result, students may share the same physical learning space without developing strong academic relationships with their classmates. In the higher education classroom examined in the present study, this issue is particularly relevant because students from different year levels enrolled in the same course and might have limited opportunities for interaction beyond short classroom encounters. This raises an important instructional question: whether learning activities can be intentionally structured to expand students' opportunities to encounter and recognize a broader range of classmates as academic resources.

Prior research on collaborative and small-group learning suggests that well-designed group tasks can promote meaningful peer interaction, engagement, and collaborative knowledge construction (Davidson & Major, 2014; Scager et al., 2016). Small-group discussion may therefore provide a practical context for developing peer relationships in the classroom. Through discussion, students can exchange ideas, clarify course content, observe classmates' thinking, and gain a better understanding of their peers' knowledge and perspectives (Parmar et al., 2025; Wentzel & Watkins, 2002). Such interactions may also help students recognize classmates as potential sources of academic support. However, when students repeatedly interact with the same group members, their opportunities to engage with classmates outside their established peer circles may remain limited. Rotating small-group arrangements, in which group membership varies across discussion sessions, can create opportunities for students to interact with a wider range of classmates (Samudra et al., 2024). Kossinets and Watts (2006) suggest that shared activities and opportunities for interaction can shape the formation of social ties. Such contact may, in turn, help students recognize a broader range of peers as potential sources of academic support.

Previous research has demonstrated the value of collaborative learning (Davidson & Major, 2014; Scager et al., 2016), and SNA has increasingly been used to examine classroom relationships and student engagement (Freire et al., 2024; Williams et al., 2019). However, less is known about whether rotating small-group discussions are accompanied by changes in students' academic help-seeking networks over time. In particular, it is important to distinguish changes in the breadth of peer recognition at the individual respondent level from changes in the structure of the whole classroom network. The former concerns how many classmates that individual students recognize as potential academic resources, whereas the latter concerns how these nominations collectively form the classroom network. Considering both levels can provide a more nuanced understanding of relational change than relying on whole-network indicators alone.

Therefore, the purpose of the present study was to examine changes in students' academic help-seeking networks from early to mid-semester in two course cohorts in which students participated in four rotating small-group discussions. Two research questions guided the study: (1) How did respondent-level nomination breadth change from early to mid-semester? and (2) How did whole-network indicators change from early to mid-semester across the two cohorts?

2. Method

2.1 Participants and Research Design

This study employed a descriptive longitudinal social network design to examine changes in classroom academic help-seeking networks from early to mid-semester across two intact course cohorts. The study involved 129 undergraduate students enrolled in a teacher-education course at a university in northern Taiwan. Students ranged from first-year to fourth-year undergraduates. The course was taught by the same instructor across two academic years, with one cohort participating in each academic year. The two cohorts followed a similar instructional design and participated in repeated small-group discussions related to course content and learning tasks.

The study used two intact course cohorts, with the classroom roster defining the boundary of each academic help-seeking network. Cohort 1 consisted of 52 students. Of these, 43 completed the nomination survey at the early-semester assessment (82.7%) and 41 at the mid-semester assessment (78.8%). Cohort 2 included 77 students at the early-semester assessment. One additional student joined the course afterward, increasing the mid-semester roster to 78. To maintain a consistent network boundary across time, the longitudinal analysis included only the 77 students present at both time points. Of these, 68 completed the early-semester nomination survey (88.3%) and 43 completed the mid-semester survey (55.8%).

Formal institutional ethics review was not obtained for this classroom-based study. Participation in the nomination survey was voluntary. Before completing the survey, students were provided with information about the study and informed consent was obtained. Only students who indicated that they understood the study information and agreed to participate were able to proceed to the nomination questions.

2.2 Procedure and Network Measure

Academic help-seeking networks were assessed twice in each cohort: during the early semester (week 2) and at mid-semester (week 9). Between the two assessments, students participated in four instructor-organized small-group discussions addressing course content and learning tasks. Group composition varied across the four discussions through different grouping procedures so that students interacted with different classmates rather than remaining in fixed groups.

At both measurement points, students completed the same roster-based nomination question concerning peer academic help seeking. They were asked to identify classmates whom they would actively consult if they encountered learning-related questions or wanted clarification of the instructor's course content. The item corresponded to the question: "If you had questions about learning or wanted to better understand the instructor's course content, which classmates would you actively ask for help?" Students could nominate classmates from within the course roster.

Each student on the course roster was represented as a node, and each nomination from one student to another was represented as a directed tie. Thus, a nomination from Student A to Student B indicated that Student A perceived Student B as a potential source of academic help. The nomination measure therefore represented students' perceived academic help-seeking resources rather than directly observed help-seeking behavior.

For each effective respondent, an observed nomination was coded as 1 and a nonnomination of another roster member was coded as 0. Self-nominations were not permitted in the analysis. An effective respondent was defined as a student who completed the nomination survey and provided usable data at the corresponding time point. Nonrespondents remained as nodes and could receive incoming nominations from respondents, but they contributed no observed outgoing nominations.

2.3 Data Preparation and Analysis

Data preparation and analysis proceeded in several stages. First, each roster-based nomination matrix was checked for consistency, including correspondence between row and column identifiers, valid nomination coding, and self-loops. Self-loops were removed before network indicators were calculated.

Second, each nomination matrix was converted into a directed edge table and a node table for network analysis. The node table contained the unique student code and relevant network attributes. The edge table contained Source and Target identifiers for each observed nomination. Because the study examined binary nomination relationships, every observed directed tie was assigned a value of 1.

Third, whole-network indicators were calculated separately for each cohort and measurement point. The primary whole-network indicators included the number of observed directed ties, network density, and nomination coverage. Density was calculated as the number of observed directed ties divided by the number of possible directed ties within the roster-defined network, excluding self-ties. Nomination coverage was calculated as the percentage of students within the roster-defined network who received at least one incoming nomination.

Fourth, respondent-level indicators were calculated to complement the whole-network measures. These included the mean number of nominations made per effective respondent and the median Out-Degree among effective respondents. These indicators represented nomination breadth among students who actually provided nomination data. They were examined alongside whole-network density because density in a roster-defined classroom network may be influenced not only by observed relational patterns but also by network size and variation in survey response across measurement points.

Network visualizations were produced using Gephi 0.11.2. Directed networks were displayed using the ForceAtlas2 layout. Node size represented In-Degree, indicating the number of nominations received by each student, and node color represented modularity class to facilitate visualization of network clustering. The visualizations were used descriptively to illustrate network structure rather than as the basis for statistical inference.

3. Results

Academic help-seeking nomination data were collected from two course cohorts at two time points, resulting in four directed classroom network datasets. For the longitudinal analyses, the network boundary consisted of 52 students in Cohort 1 and 77 students in Cohort 2. The analyses focused on three complementary aspects of network change: (a) visual patterns in the configuration of academic help-seeking networks, (b) whole-network characteristics, including the number of directed ties, density, and nomination coverage, and (c) respondent-level nomination breadth, assessed using the average number of nominations per effective respondent and median Out-Degree. The results are presented in this sequence to distinguish changes in overall network structure from changes in nomination patterns among students who provided usable nomination data.

3.1 Academic Help-Seeking Network Visualizations Across Cohorts and Time Points

Figure 1 presents the academic help-seeking networks for Cohort 1 and Cohort 2 at the early- and mid-semester time points. Across the four visualizations, students were represented as nodes and nomination ties as directed edges. Node size reflected In-Degree, indicating the number of nominations received by each student as a potential source of academic help, whereas node color represented modularity class.

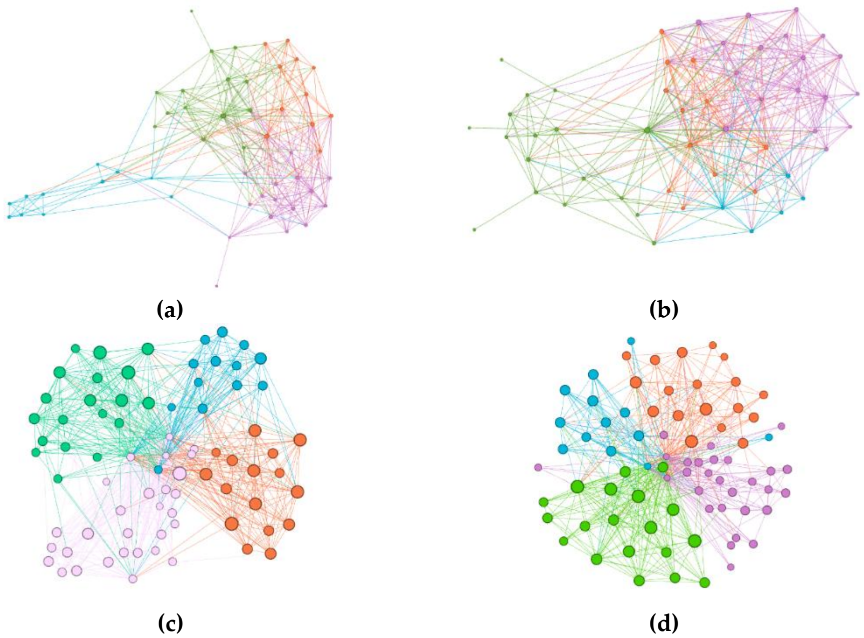

Figure 1. Academic Help-Seeking Networks Across Two Cohorts and Two Time Points

Note. (a) Cohort 1 early-semester network; (b) Cohort 1 mid-semester network; (c) Cohort 2 early-semester network; and (d) Cohort 2 mid-semester network. Nodes represent students, and directed edges represent academic help-seeking nominations. Node size indicates In-Degree, representing the number of nominations received by each student, and node color indicates modularity class.

The visualizations showed different patterns across the two cohorts. In Cohort 1, the early-semester network included a loosely connected peripheral cluster extending away from the main network, with relatively limited connections to the rest of the class. By mid-semester, this peripheral pattern was less pronounced, and the network appeared more visually integrated. Compared with the early-semester visualization, the mid-semester network also displayed a larger number of visible ties and fewer visibly isolated structures.

In Cohort 2, the visual pattern was more complex. The early-semester network showed several relatively compact and visually distinguishable communities. By mid-semester, community structures remained visible, but the boundaries between them appeared less distinct. Several nodes were positioned near the boundaries between communities, and greater visual overlap among modularity classes was evident.

Taken together, the four visualizations showed different trajectories across the two cohorts. Cohort 1 displayed a clearer visual movement toward network integration, whereas Cohort 2 retained a more complex community structure with greater overlap among communities at mid-semester. Because network layouts provide descriptive representations rather than quantitative evidence of structural change, these visual patterns were interpreted in conjunction with the network indicators reported in Table 1.

3.2 Whole-Network Characteristics Across Cohorts and Time Points

Table 1 summarizes the main whole-network and respondent-related indicators for the two cohorts at the early- and mid-semester time points. The network boundary consisted of 52 students in Cohort 1 and 77 students in Cohort 2. The number of effective respondents, defined as students who completed the nomination survey and provided usable data at the corresponding time point, varied across time points. In Cohort 1, the number of effective respondents decreased slightly from 43 at the early-semester assessment to 41 at mid-semester. In Cohort 2, the decrease was more substantial, from 68 to 43.

Whole-network patterns differed between the two cohorts. In Cohort 1, the number of directed ties increased from 440 at the early-semester time point to 543 at mid-semester, accompanied by an increase in density from 0.1659 to 0.2048. In Cohort 2, by contrast, the number of directed ties decreased from 893 to 629, and density decreased from 0.1526 to 0.1075. Nomination coverage remained stable across time points within each cohort, at 98.08% in Cohort 1 and 100.00% in Cohort 2.

Thus, the two cohorts showed different whole-network trajectories. Cohort 1 exhibited greater observed network connectivity at mid-semester, whereas Cohort 2 exhibited lower whole-network connectivity. Because the decrease in Cohort 2 occurred concurrently with a substantial reduction in the number of effective respondents, respondent-level nomination indicators were examined separately in the following section.

Table 1. Network Indicators Across Two Cohorts and Two Time Points

Indicator	**Cohort 1 Early**	**Cohort 1 Mid**	**Cohort 2 Early**	**Cohort 2 Mid**
Nodes	52	52	77	77
Effective respondents	43	41	68	43
Directed edges	440	543	893	629
Density	0.1659	0.2048	0.1526	0.1075
Average nominations per effective respondent	10.23	13.24	13.13	14.63
Median Out-Degree among respondents	9	9	8	10
Nomination coverage	98.08%	98.08%	100.00%	100.00%

Note. Effective respondents were defined as students who completed the nomination survey and provided usable data at the corresponding time point. Self-loops were excluded from the calculation of network indicators. For Cohort 2, the mid-semester indicators were calculated using the stable 77-student network boundary retained for longitudinal comparison; the student who joined the course after the early-semester assessment was excluded from the main analysis.

3.3 Respondent-Level Nomination Breadth Increased in Both Cohorts

The most consistent respondent-level pattern across the two cohorts was an increase in nomination breadth from early to mid-semester. In Cohort 1, the average number of nominations per effective respondent increased from 10.23 to 13.24. In Cohort 2, the corresponding value increased from 13.13 to 14.63. Thus, among effective respondents, the average number of classmates nominated as potential sources of academic help was higher at mid-semester than at the early-semester time point in both cohorts.

The median Out-Degree among effective respondents provided additional information about the distribution of these changes. In Cohort 1, the median Out-Degree remained unchanged at 9 from early to mid-semester despite the increase in the average number of nominations. This pattern indicates that the increase in average nomination breadth was not uniformly distributed across respondents and was more evident among students in the upper portion of the Out-Degree distribution. In Cohort 2, by contrast, the median Out-Degree increased from 8 to 10, consistent with a more broadly distributed increase in nomination breadth among effective respondents.

Taken together, respondent-level nomination breadth was higher at mid-semester in both cohorts, although the corresponding whole-network patterns differed. In Cohort 1, the increase in respondent-level nomination breadth occurred alongside increases in the number of directed ties and network density. In Cohort 2, respondent-level nomination breadth also increased, whereas the number of directed ties and whole-network density decreased. The concurrent decline in the number of effective respondents in Cohort 2 should therefore be considered when interpreting the difference between respondent-level and whole-network patterns.

4. Discussion

The present study examined how classroom academic help-seeking networks changed from early to mid-semester across two course cohorts in which students participated in repeated rotating small-group discussions. Two main findings emerged. First, respondent-level nomination breadth increased in both cohorts: effective respondents nominated more classmates on average at mid-semester than at the beginning of the semester. Second, the whole-network patterns differed between cohorts. Cohort 1 showed increases in both directed ties and network density, whereas Cohort 2 showed decreases in these whole-network indicators despite an increase in respondent-level nomination breadth. The latter pattern occurred alongside a substantial decline in the number of effective respondents in Cohort 2. Taken together, these findings suggest that respondent-level nomination breadth and whole-network density capture different aspects of classroom academic help-seeking networks and should be interpreted jointly.

4.1 Repeated Rotating Small-Group Discussions May Broaden Recognition of Peer Academic Resources

The increase in respondent-level nomination breadth observed in both cohorts is consistent with the possibility that repeated rotating small-group discussions may help students recognize a broader range of classmates as potential academic help-seeking resources. During the period between the two network assessments, students participated in four small-group discussions in which group composition varied across activities. By mid-semester, effective respondents in both cohorts nominated more classmates on average as people they would consult for learning-related questions. The network visualizations also showed changes in classroom structure, although the visual trajectories differed across the two cohorts.

This interpretation is consistent with prior work emphasizing the educational importance of peer relationships in classroom learning. Wentzel and Watkins (2002) suggested that peer relationships can provide opportunities for students to exchange academic information, clarify misunderstandings, receive encouragement, and participate in collaborative learning. From this perspective, a broader range of academic help-seeking nominations may reflect greater awareness of classmates as accessible learning resources. MacGregor (2000) similarly emphasized that meaningful academic engagement with peers can contribute to students' participation in university learning. The present findings extend this perspective by illustrating how students' recognition of potential peer academic resources may change over the course of repeated classroom interaction.

One possible mechanism is increased contact with classmates outside students' usual peer circles. Rotating group arrangements provide opportunities for students to observe how different classmates explain concepts, organize information, respond to questions, contribute ideas, and interact during academic tasks. Through these encounters, students may acquire information about which classmates are knowledgeable, approachable, or helpful. Peer academic resources that were previously unknown or less visible may therefore become more recognizable. In this sense, rotating discussions may function not only as opportunities for completing immediate learning tasks but also as occasions for students to learn about the academic resources available within the classroom.

However, this mechanism should be regarded as a plausible interpretation rather than a demonstrated causal pathway. Students may also become more familiar with classmates naturally as the semester progresses, regardless of formal group rotation. Other classroom activities, informal interaction, friendship development, seating patterns, or contact outside the course may also influence whom students recognize as potential sources of academic help. Thus, although the parallel increase in respondent-level nomination breadth across both cohorts is consistent with the proposed role of repeated peer contact, the present design cannot determine how much of the observed change resulted specifically from the rotating small-group discussions.

The findings also suggest that the development of an academic help-seeking network need not involve every student becoming connected to everyone else in the classroom. A potentially meaningful change may instead occur when students expand the set of classmates whom they regard as viable sources of academic assistance. From this perspective, the increase in nomination breadth may represent a broader peer-recognition structure rather than simply greater network density. This distinction is particularly important because the two cohorts showed similar respondent-level changes despite different whole-network trajectories.

4.2 Response Patterns and the Interpretation of Whole-Network Density

The Cohort 2 findings highlight the importance of interpreting whole-network density in relation to response patterns and network boundaries. In Cohort 2, density decreased from 0.1526 at the early-semester time point to 0.1075 at mid-semester. Considered in isolation, this decrease might appear to indicate that the academic help-seeking network became less connected over time. Such an interpretation, however, requires caution because the number of effective respondents declined substantially from 68 to 43 while the network boundary remained fixed at 77 students.

This distinction is important because network density represents the proportion of observed ties relative to all possible ties within the defined network boundary. At the Cohort 2 mid-semester assessment, the denominator continued to reflect all possible directed relationships among 77 students, whereas only 43 students completed the nomination survey and provided usable nomination data. As Kossinets (2006) showed, missing network data can alter observed structural properties and complicate the interpretation of network-level measures. Borgatti et al. (2006) likewise noted that network measures may be sensitive to incomplete or erroneous data, although the degree of sensitivity varies across measures and network conditions.

The contrast between whole-network and respondent-level indicators in Cohort 2 illustrates this issue. At the whole-network level, the number of directed ties decreased from 893 to 629 and density decreased from 0.1526 to 0.1075. At the respondent level, however, the average number of nominations per effective respondent increased from 13.13 to 14.63, and the median Out-Degree increased from 8 to 10. Thus, among students who provided usable nomination data, nomination breadth was greater at mid-semester even though the observed network was less dense when the complete 77-student network boundary was retained.

Whole-network density and respondent-level nomination breadth therefore capture related but distinct aspects of network structure. Density indicates the extent to which observed ties occupy all possible relationships within the bounded classroom network, whereas respondent-level indicators describe the breadth of nominations among students who actually provided usable nomination data. In bounded classroom networks, the interpretation of density may therefore be influenced not only by underlying patterns of social connectedness but also by network size, response rates, and decisions regarding the treatment of nonrespondents. Neither whole-network nor respondent-level indicators should be treated as a substitute for the other; rather, they provide complementary perspectives on network change.

This distinction has important methodological implications for classroom network research. If density were interpreted alone, the Cohort 2 results might be mistakenly read as evidence that peer academic support declined over time. When density is considered together with response patterns and respondent-level nomination breadth, however, a more nuanced interpretation emerges: observed whole-network connectivity decreased, while students who provided usable nomination data identified a broader range of classmates as potential academic help-seeking resources. The apparent divergence between these indicators does not necessarily represent a contradiction; instead, it reflects the different levels of network information captured by each measure. Accordingly, longitudinal classroom network studies should report response patterns explicitly and interpret whole-network density alongside respondent-adjusted indicators, particularly when participation varies across measurement occasions.

4.3 Educational Implications

The findings offer several implications for instructors who use small-group discussions in university classrooms. First, the educational value of repeated small-group discussion may extend beyond the immediate completion of a learning task. When students interact with different classmates across activities, they may gain opportunities to discover who can clarify course concepts, contribute useful perspectives, discuss assignments, or provide learning-related support. Thus, group discussion may contribute not only to task-focused learning but also to students' awareness of the relational resources available within the classroom.

Second, group composition can be treated as an intentional component of instructional design. Fixed groups provide continuity, familiarity, and opportunities for sustained collaboration, but they may also concentrate students' interactions within a relatively limited set of classmates. Rotating groups, in contrast, can broaden opportunities for contact across existing peer circles. When an instructional goal includes helping students encounter a wider range of potential learning partners, varying group membership across selected activities may therefore be useful.

This does not mean that rotating groups should replace stable groups or that frequent regrouping is appropriate for every learning task. Different arrangements serve different pedagogical purposes. Stable groups may be preferable when students need to build trust, coordinate complex work, or develop a shared product over time, whereas rotating groups may be more useful when instructors want to increase cross-class interaction or expose students to different perspectives and peer resources. A deliberate combination of stable and rotating arrangements may therefore be more appropriate than treating either format as universally preferable.

Third, the findings suggest that instructors interested in developing classroom peer-support structures should attend not only to whether students participate in discussion but also to whom they have opportunities to interact with. A classroom may contain considerable academic expertise without that expertise being equally visible or accessible to all students. Designing activities that create meaningful academic contact across different peer groups may help make these resources more recognizable. From this perspective, group composition becomes part of the relational design of the learning environment rather than merely a logistical decision about how students are divided into teams.

4.4 Limitations and Future Directions

Several limitations should be considered when interpreting the findings. First, differences in response patterns may have introduced nonresponse bias, particularly in Cohort 2, where the number of effective respondents declined substantially at mid-semester. If students who did not provide usable nomination data differed systematically from respondents in their classroom involvement, academic engagement, or peer relationships, the observed network structure may not fully represent the underlying academic help-seeking network. Respondent-level indicators clarify the nomination patterns of effective respondents, but they cannot compensate for potentially systematic nonresponse.

Second, the study employed a descriptive observational design and did not include a comparison group or random assignment. Consequently, the observed changes cannot be attributed solely to the rotating small-group discussions. As noted above, increasing familiarity over the course of the semester, other instructional activities, informal peer interaction, or developments in friendship networks may also have contributed to changes in academic help-seeking nominations. The rotating discussions were embedded within ordinary course instruction rather than implemented as a controlled experimental intervention; therefore, the present study was not designed to assess intervention fidelity or isolate a specific causal mechanism.

Third, the network measure captured perceived academic help-seeking resources rather than actual help-seeking behavior. A nomination indicated that a student regarded a particular classmate as someone they would consult for a learning-related question, but it did not establish whether an actual help-seeking interaction occurred. The binary nomination measure also did not capture the frequency, intensity, quality, reciprocity, or effectiveness of assistance. An increase in nomination breadth should therefore be interpreted as an expansion in perceived potential academic resources rather than direct evidence that students sought or received more academic help.

Fourth, the analyses were descriptive rather than inferential. No formal hypothesis tests or standardized effect sizes were estimated; consequently, the observed differences should not be interpreted as statistically established effects. The study instead focused on the direction and pattern of network change across two naturally occurring cohorts. Future studies with larger numbers of classrooms and designs permitting statistical modeling of longitudinal network change could provide stronger evidence regarding the magnitude and consistency of these patterns.

Fifth, the generalizability of the findings is limited by the study context. Both cohorts were drawn from the same teacher education course at one university in northern Taiwan and were taught by the same instructor. Peer help-seeking networks may develop differently across disciplines, institutions, class sizes, instructional formats, cultural contexts, or courses with different expectations for collaboration. The present findings should therefore be regarded as evidence from a specific classroom context rather than as patterns that can automatically be generalized to university classrooms more broadly.

Future research could address these limitations by combining social network analysis with other forms of evidence. Interviews or open-ended responses could help explain why particular classmates become recognized as academic resources and what characteristics make peers more approachable or useful. Records of actual peer interaction could distinguish perceived help-seeking opportunities from realized help-seeking behavior. Additional measurement points could reveal when changes in peer recognition occur and whether they persist later in the semester. Studies comparing rotating and stable grouping arrangements across multiple classrooms would also provide stronger evidence regarding whether particular grouping practices contribute to changes in peer academic help-seeking networks.

Despite these limitations, the present study highlights an aspect of classroom interaction that may be overlooked when small-group discussions are evaluated only in terms of immediate participation or task performance. The findings suggest that the relational consequences of classroom grouping may also matter: repeated opportunities to interact with different classmates may help students recognize a wider range of peers as potential academic resources. At the same time, the contrast between whole-network and respondent-level findings demonstrates that classroom network change cannot be adequately understood through a single indicator such as density. More broadly, the study suggests that the design of peer interaction may influence not only what students learn together during a particular activity, but also how the classroom develops as a network of potential academic support.

4.5 Conclusion

Despite these limitations, the present study contributes to understanding classroom peer learning by distinguishing between changes in whole-network structure and changes in the breadth of academic resources recognized by responding students. Across two cohorts, respondent-level nomination breadth increased from early to mid-semester, whereas whole-network density followed different trajectories. This pattern suggests that the development of peer academic resources should not be understood solely in terms of whether an entire classroom network becomes denser.

If replicated in other educational settings, the findings suggest a practical value of repeated rotating small-group interaction: such activities may help make a wider range of classmates visible as potential sources of academic support. From this perspective, an important educational outcome of classroom interaction may be not simply greater overall connectivity, but an expansion of the peer resources that students perceive as available when academic questions arise. More broadly, the findings underscore the value of examining classroom learning as a relational process in which instructional arrangements can shape students' opportunities to recognize and potentially access peer-based academic resources.

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