The Mutual Preference Method: Capitalizing on Student Relationships to Guide Group Formation

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ABSTRACT
Students working in groups experience positive outcomes in both academic and affective domains. Well-functioning groups contribute to a robust, active-learning classroom community. The literature contains a vast assortment of methods for the formation of student groups; nonetheless, the formation and evaluation of student groups formed by various methods continue to be valuable topics for research and discussion. Here we describe the mutual preference method (MPM), a novel procedure for group formation that pairs students based on a list of preferred collaborators that each student generates. The MPM is a unique approach to group formation meant to capitalize on existing student social structures, increase metacognition, promote habits in professionalism, and create productive groups.

Key Words group formation; undergraduate biology; teamwork; inclusive pedagogies; mutual preference; group activities; group assignments; student groups.

Introduction
Group work inside and outside of class has been shown to increase academic success in science education (Eddy & Hogan, 2014). This is believed to occur because of the strong microenvironments that emerge among students in the classroom (Armstrong, 2011). In healthy groups, these microenvironments can increase metacognition since group members become conscious of the different ways that students learn and how they themselves learn in contrast (Silverthorn, 2020). Working in groups can also increase students’ transferable soft skills, such as critical thinking and problem solving (Klegeris, 2021). Utilization of groups in the classroom can be helpful, as many aspects of the class climate can cause disengagement in students, such as the lecture and activity structure, the instructor’s demeanor, the classroom’s layout, and even interactions among the students themselves (Gutiérrez et al., 2017; Metzger, 2015). Here, we present the mutual preference method (MPM), a process designed to improve student engagement by predicting optimal groupings of students from student responses that reveal already existing social structures.

The Mutual Preference Method
In the MPM, students are grouped together based solely on two fundamental axioms:
• Students that list each other will be grouped together whenever possible.
• If a student lists another student, and the second student does not reciprocate, that pair of students will be barred from being grouped together.

There are two fundamental types of student groups: instructor-created and self-selected (Post et al., 2020). Creating self-selected groups entails allowing students to form groups themselves, and polling reveals that students prefer this method above others (Pociask et al., 2017). Self-selected groups are typically formed around friendships between peers; while such teams can demonstrate great cooperation and synergy, they can also have difficulty staying on task (Smith, 2018). Instructor-selection methods vary widely, ranging from simple random groups to complex data-mining and processing. One such complex method is able to achieve significant increases in assignment grade by analyzing student discussion data and pairing students based on the transactivity of their conversation (Wen et al., 2016). Alternatively, some methods center around classifying students into distinct roles and constructing groups that contain members of every role (Lin & You, 2021). Compared to more in-depth methods, random groups are simpler to implement but run the risk of creating unbalanced or dysfunctional teams. Our approach combines aspects of self-selection and teacher selection methods by pairing students by preference when possible and then filling gaps with random students until groups are the desired size.
to avoid working with them again. In this way, the MPM not only allows students to have an impact on their group composition but ensures that the desire to collaborate is mutual.

Together, the first and second axioms act to form and prune groups respectively, and groups built from this method are intended to balance comfort and unfamiliarity. Class interventions such as this that aim to increase student engagement are becoming increasingly important in the shift toward active learning in college education.

○ Procedure

To begin, students are asked to list other students whom they feel that they work well with. Using the phrasing “work well with” may be important since it promotes analyzing group members based on effectiveness rather than friendship. After the student data is collected, the groups are ready to be formed.

Creation of Groups in Four Steps

1. Divide the total number of students by your desired group size to yield N groups.
2. For each student, check whether the students they list also list them back. If the student is listed back, mark it as a match. If not, mark it as a fail.
3. Create pairs starting with students that match until you have N pairs.
4. Add the remaining students to the pairs until the desired group size is reached.
   • Ideally, additional matches are added into the group when possible, and random students when not.
   • Whether a student matches with another in the group or not, make sure they are not on the fail list of anyone else in the group before adding them.

○ Utilization of Technology to Aid Group Formation

The above process becomes extremely involved as classes increase in size. Use of software such as R (R Core Team, 2019) in tandem with specialized social network analysis packages such as igraph (Csardi & Nepusz, 2006) makes this process manageable in larger classrooms (for additional information, see Supplemental Material available with the online version of this article). For instance, using these tools enables the rapid and exhaustive identification of mutually listed pairings within a class. However, care must be taken to ensure that the data is clean and that the names reported by students match up with the names of their peers enrolled in the course.

○ Results & Discussion

This process yields groups of students who either have mutually listed each other as preferred collaborators or did not list each other at all. This process was performed in two sections of a foundational first-year undergraduate biology course, Integrative Biology. The resulting groups demonstrated cooperation skills measured by the level of active participation in group activities.

After working in groups formed from this method for a number of weeks, students were asked whether their definition of “working well” with others has changed. Almost every student that was polled responded with a resounding “yes,” indicating that the MPM is eliciting some level of metacognition in the students. This change in perspective may lead to very different student groups if the class was polled a second time. New directions for the MPM or other methods like it may utilize cycles of formation, allowing students to reflect and grow along the way. Further investigating this perspective shift in students and ways to interact with it through methods such as the MPM may yield additional tools to maximize educator effectiveness.

Working with this data has the added benefit of helping the faculty gauge the initial class climate and identify instances that would benefit from more intentional monitoring. Much can be learned about the relationships among students just by observing patterns in the students that they list. Some students are at the center of obvious clusters of matches, which may indicate qualities of leadership. On the other hand, some students distinctly list no one, or even respond to the prompt saying that they do not know anyone, in which case faculty can pay particular attention to ensure such students develop connections to other students and a sense of belonging in the classroom community.

The MPM was developed and employed as an exploratory effort to create well-functioning groups. Future investigations could include analyses of the educational gains and social impacts associated with usage of the method. Such research can be difficult to perform due to confounding variables and/or small sample sizes, but with care, these obstacles can be mitigated. Continuing to explore potential ways to maximize classroom inclusion and cooperation will undoubtedly contribute to higher quality active-learning environments.

Figure 1. Sample triads for evaluation using MPM. (A) In this triad, all three students express their willingness to work together, allowing them to form an acceptable group. (B) In this triad, Kendal and Morgan are willing to work together, while Jewel was not mentioned by and did not mention either Kendal or Morgan. This group of three would be acceptable. (C) In this triad, all students listed peers who did not reciprocate, meaning that none of the three students would be allowed to be in a group with either of the other two. (D) In this triad, Kendal and Morgan mentioned each other, but Jewel’s mention of Kendal was not reciprocated. This triad would not make an acceptable group.
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