Team Formation in a Blended Learning System: Student Perspectives

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***Abstract*—While the social interaction in collaborative learning contributes to knowledge construction, its exact mechanisms are not yet fully understood. In this paper we present the results of a survey that sheds some light on one aspect of this issue: the students' perspectives on team formation in collaborative learning environments. We surveyed a class of undergraduate students studying in a blended learning environment using team-based lab assignments. We solicited the students' perspectives on four different computer-supported team formation approaches, and we asked about their views on different factors shaping their team formation preferences. We hope that the results of our survey will help researchers and learning system designers to better understand the perspective of students and the reasons why students generally prefer team self-formation over instructor or system formed teams.**

***Index Terms*—Collaborative learning, learning management systems, team formation**

I. Introduction

The social interaction in collaborative learning is known to contribute to knowledge construction, but its exact mechanisms are still uncertain [1]. As Miyake and Kirschner state, "fruitful collaboration is not merely a case of putting people with relevant knowledge together. We must understand the factors that make up successful collaboration" [3]. They propose a "team learning model" which serves to explain a team's willingness to engage in learning behavior. The model combines a view of collaboration as a social process of knowledge building with a view of the social environment in which learning takes place. The model is driven by five team learning beliefs: interdependence, social cohesion, task cohesion, group potency, and psychological safety. Three of those beliefs, *social cohesion* ("the nature and quality of the emotional bonds of friendship such as liking, caring, and closeness among group members"), *group potency* ("the collective belief of group members that the group can be effective"), and *psychological safety* ("a shared belief that the team is safe for interpersonal risk taking"), are directly affected by team formation. In an evaluation of their model they found that social cohesion was not related to team learning behavior, but that group potency and psychological safety were clearly related.

In this paper we investigate *team formation*, an aspect of collaborative learning that directly affects group potency and psychological safety. While evidence-based guidelines for team formation recommend instructor-formed teams [2], a survey of 6435 engineering students found that 67% of their teamwork experience was based on student-selected teams [1]. Thus, despite the recommendations against it, a majority of instructors seem to favor student-selected teams. The survey also found a (weak) negative correlation between instructor team selection and students' satisfaction with the team. That is, students seemed to report a worse teamwork experience for instructor-selected teams.

Besides surveys and guidelines like the ones above, there is also a rich body of work on approaches to *automatically* form teams to achieve the best performance (e.g., by combining learner profiles and context [4] or by using learner strategies [5]). In this paper, we do *not* focus on the effect of team formation on performance, but we shed light on students' opinions about different team formation approaches. We survey a class of undergraduate computer science freshmen studying in a blended learning environment using team-based lab assignments. We solicit their perspectives on four different computer-supported team formation approaches, and we ask them about their views on the different factors shaping team formation preferences.

Section II presents the context in which we conducted this study. Section III introduces the four proposed team formation approaches. Section IV discusses the students' perspectives on the different factors affecting team formation, Section V presents their views on the four team formation approaches, and Section VI concludes.

II. Background: Informa Blended Learning System

Informa[1] is a learning platform that supports various forms of blended learning. A key feature of Informa is its team-based lab assignments. A lab assignment in Informa is a web page that interleaves problem descriptions with various questions. Some questions ask students to simply enter a textual answer, while others require that students upload an artifact. Instructors can configure labs to be solved in teams, and they can specify the team size for each lab.

Before an instructor can assign a lab, they need to form teams. The initial implementation of Informa required that instructors create teams manually, which was laborious for large classes. Later versions provided automated random team formation. Our expectation was that instructors would create

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[1] Informa is deployed at the Università della Svizzera itailiana at https://informa.inf.usi.ch/ and most of the content of the ongoing courses is publicly accessible.

different teams for each individual assignment. The advantages of this random assignment approach are that students get exposed to a diverse set of peers that use a diverse set of problem solving approaches, and that the randomization pairs each student with a balanced set of stronger and weaker peers over the course of a semester. However, when we created randomized teams for the first time, we were surprised by the amount of negative feedback from the students. We decided to better understand the students' perspectives on team formation by conducting a survey. This paper reports the results of that effort.

III. Team Formation Approaches

In our survey, we confronted the students with descriptions of four different team formation approaches. These approaches describe *how* students are assigned to teams, but they do not describe *when, or how often* teams are formed.

The question of how long teams should last is somewhat orthogonal to the approach used to form teams. On one extreme, teams could be formed once, at the beginning of the course, and be kept stable throughout the course. This is the situation targeted by Oakley et al.'s best practices [1]. On the other extreme, teams could be formed for each assignment and last just for the duration of that assignment. This is a situation where team formation needs to be lightweight and fast, and where the consequences of a suboptimal team assignment are less dramatic. Any intermediate point between these two extremes is possible, too.

A. Random Assignment

The first approach represents the initial implementation available in Informa: The learning system randomly assigns students to teams. In the extreme case, neither the students nor the instructor has any influence on the team composition. Alternatively, the instructor might be able to modify the team assignments, possibly based on requests from students.

B. Do-It-Yourself Assignment

The second approach is to completely delegate team assignment to the students. In a computer-supported environment, the learning system allows every student to modify the team assignment. Students might be able to place themselves in any team they want, or they might even be able to re-assign other students (e.g., move other students into or out of their team). At a certain deadline, the system would disable the feature for students to modify team assignments, would randomly remove students from teams that have more than the maximum number of students, and would randomly assign students who are in no team.

C. Buddy Preferences

The third approach would allow students to specify a set of preferred buddies. The learning system would then try to create a team assignment that satisfies the buddy preferences to the degree this is possible, and then randomly assign the remaining students.

D. Performance-Based Assignment

With the fourth approach, the learning system would automatically assign students to teams based on their past performance (e.g., based on past quiz and assignment scores). This is a form of group formation based on learner profiles [4]. This probably would have to be redone for each assignment, because a students' performance is not known in the beginning, and it will change throughout the course.

IV. Perspectives on Teamwork

We asked 55 students who used Informa in a second-semester Bachelor programming course to complete our survey. We conducted the anonymous survey after the first lab assignment, where we had used random assignment for team formation. We received 47 responses (85% response rate).

A. Working Alone vs. Teamwork

Given that not all students like to work in teams, the first question we asked was "Would you prefer working on labs on your own, or working on labs collaboratively?" Students answered on a scale from 1 (more individual) to 5 (more collaborative). Fig. 1 summarizes the 47 responses. It shows a clear preference for teamwork, with a notable minority of students who prefer to work on their own.

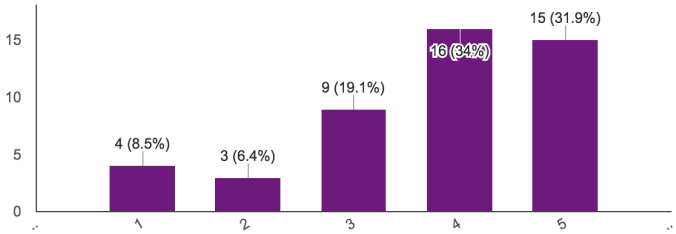

Fig. 1 Number of students preferring more individual (1) or more collaborative (5) work

B. General Team Assignment Preferences

Our survey then listed a set of potential advantages of different team formation approaches and asked students to rate each advantage on a scale from 1 (unimportant) to 5 (very important). If not stated otherwise in the following paragraphs, all 47 participating students provided a response.

The first advantage was "Don't get stuck with a team member I don't want to work with". As Fig. 2 shows, the students overwhelmingly found this to be an important aspect.

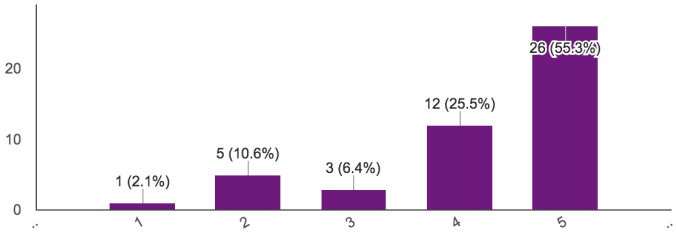

Fig. 2 Don't get stuck with a team member I don't want to work with

The second advantage was "Possibility to work with a friend". Fig. 3 shows that students still found this to be an important

advantage, but they placed less importance on this than on not getting stuck with a suboptimal team member.

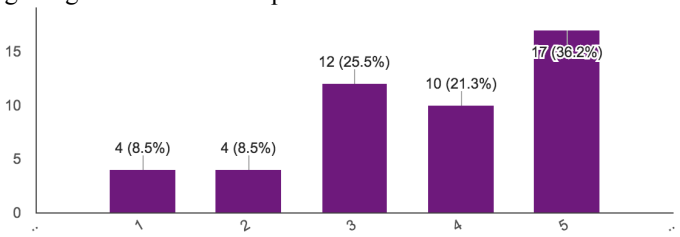

Fig. 3 Possibility to work with a friend

Note that these first two advantages are related: the first is about excluding undesired team members, while the second is about including desired team members. Apparently, students are somewhat more concerned about the former.

The third advantage was "Advantage of not having to change teams each week". Fig. 4 shows that a majority of the students found this to be an important aspect.

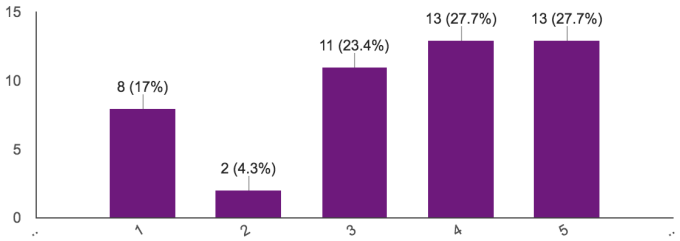

Fig. 4 Advantage of not having to change teams each week

The fourth advantage was "Opportunity to experience different people's problem solving approaches". Only 46 of the 47 responding students answered this question. While we see this as a central aspect of team formation, Fig. 5 shows that the students found this aspect to be less important than the previous ones.

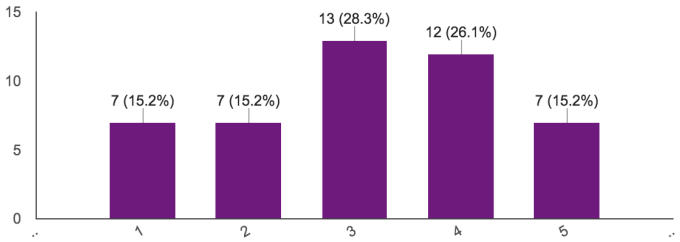

Fig. 5 Opportunity to experience different people's problem solving approaches

As Fig. 6 shows, the fifth advantage, "Opportunity to improve my own understanding by explaining things to a 'weaker' partner" found even less support. We suspect students did not appreciate the idea that teaching something is a great way to learn, and they primarily worried about a weaker partner slowing them down.

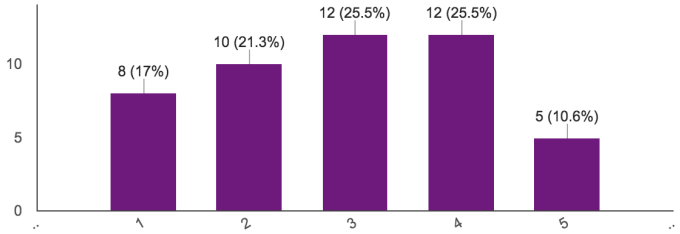

Fig. 6 Opportunity to improve my own understanding by explaining things to 'weaker' partner

Fig. 7 shows that the sixth advantage, "Opportunity to learn from a 'stronger' partner," was considered more important than the opportunity to learn from explaining to a 'weaker' partner. However, students only seemed to consider this aspect to be of secondary importance, as only 12.8% of students ranked it as "very important".

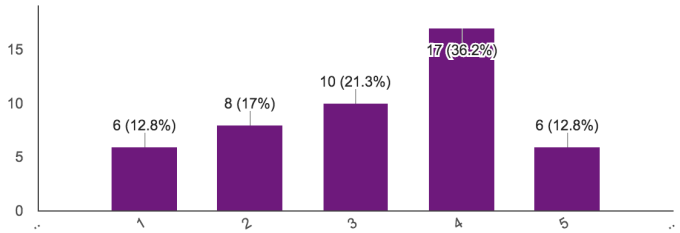

Fig. 7 Opportunity to learn from a 'stronger' partner

Overall, this first part of the survey showed that students first and foremost are worried about being stuck with a partner they do not want to work with, and that they do not see a significant benefit in explaining things to a weaker partner.

V. Perspectives on Team Formation

The second part of our questionnaire concerned the four proposed team formation approaches. We asked students to comment on each of the four approaches, and we then analyzed the comments using an open coding approach. We did this by tabulating the free-text comments about the four presented approaches, going through the table, and assigning tags to each comment. We then iterated until the set of tags stabilized. We also assessed whether a comment was mostly in favor or mostly against an approach.

A. Random Assignment

The students did not like random team formation. Of the 42 responses to this question, 6 were mostly in favor and 15 were mostly against using random team assignment. There was a strong concern of getting stuck with a suboptimal partner: 9 students argued that for the reason of fairness, random team assignments would require repeatedly changing teams. This argument was countered by the great concern about the cost of repeatedly changing teams: 13 students brought up the significant organizational and scheduling costs to students whenever they get assigned to a new team. Moreover, two students mentioned the benefit of working with their peers over a longer duration, to get to know them better, and to grow into a well working team. A small number of students appreciated the diversity of students (5) and problem solving approaches (5) they would get exposed to in randomly assigned teams. A larger number of students were concerned

that a random assignment might pair them with peers they would not like (9), that would not have an appropriate work ethic (14), or that would be significantly weaker (10).

B. Do-It-Yourself Assignment

This was the students' favorite approach. Of the 41 responses to this question, 29 were mostly in favor, and 5 were mostly against using do-it-yourself team assignment. A few students explicitly brought up the advantage of forming teams in which they get along with their peers (3), in which their peers had similar work ethics (2), or in which peers were similarly strong (1). Three students explicitly mentioned the potential reduction in organizational overhead. However, a small minority mentioned the loss of diversity in terms of people (4) and problem solving approaches (3). And two students mentioned that such student-driven team-formation would potentially be bad for the weaker students amongst them, because they would have little chance to end up in a team with a strong peer.

C. Buddy Preferences

Team formation based on buddy preferences was the second strongly favored approach. Of the 38 responses to this question, 24 were mostly in favor, and 7 were mostly against using buddy preferences for team assignment. Like in the do-it-yourself assignment approach, also here in the buddy preference approach, two students commented on the potentially negative consequences for weaker students who might not appear in any buddy list, and thus might get randomly paired with other weak students. Two students proposed to use the approach as an "anti-buddy list", where students would essentially include most of their peers in their buddy list, and would only exclude those peers they clearly did not want to work with. A small number of students saw a reduction in diversity of people (3) and diversity in problem solving approaches (2) and thus recommended to re-assign teams periodically (based on the potentially changing buddy lists and on some degree of randomization) to add diversity. One student proposed to ask teammates to assess their teamwork performance after each assignment, and to re-assign teams that do not work together well.

D. Performance-Based Assignment

Quite surprisingly, this was the least favored approach. Of the 40 responses to this question, 7 were mostly in favor, and 24 were mostly against performance-based team assignments. We did not specify whether we would use homogeneous or heterogeneous grouping, and 9 students commented on that point. Four students mentioned that the academic performance of a student was not very important when looking for teammates, but that other factors were more important to them. Two students mentioned that the aspects of performance that would affect team effectiveness were difficult to measure. Eight students mentioned that performance-based assignment was bad for weak students. On the other hand, three students commented that it would be bad for strong students in case of heterogeneous groups, in that strong students would do all the work and learn nothing from the weak students.

VI. Conclusion

The results of our survey showed that the students preferred a do-it-yourself approach to team formation. Buddy preferences, which still gives students a say but automates much of the process and uses randomization to break ties, came in as a close second. Students clearly disliked randomized assignment and performance-based assignment. While students were worried about having to work in suboptimal teams, they were less concerned about the academic strength of their peers than about getting along with them on a personal level and about their motivation and work ethic. Moreover, students repeatedly mentioned that organizing a schedule for their team was a significant cost, and that thus teams should be built based on their preferences (which presumably would include the ability to find a common work schedule). This indicates that students appreciate context-driven team formation [4]. Finally, students strongly rejected performance-based team formation; this correlated with their comments that the academic strength was not necessarily a major factor in choosing teammates.

The method of this study, a survey asking students about their opinions and preferences, is clearly limited. Its validity is threatened by the small number of students, in a single course, with a single instructor. The reliability of the open coding is limited because the coding was performed by a single person. Moreover, the study does not evaluate the *effectiveness* of different team formation approaches. It focuses exclusively on eliciting and understanding *students' perspectives* on team formation. Our results help to understand *why* students oppose or favor certain kinds of team formation approaches, and what factors they consider most important. We hope that our results help learning system developers and instructors to better communicate and explain their chosen team formation approach to their students. This way, instructors can select those team formation approaches that have been shown to lead to the best team performance and learning outcomes, and they can better help their students understand the benefits of the most promising approaches.

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