

1 Diskusjon

Key factors for determining suitable learning partners: Improving current practices of student grouping

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Abstract: Working in groups is an important part of learning that equips students with the collaboration skills they will need when entering the workforce. Despite this, there is a lack of effective means for meaningful group formation in higher education today.

While several studies are centered around developing and testing new methods of group formation, there is a lack of studies where the opinions of the students are consistently taken into account. The aim of our paper is to determine the factors most indicative of suitable learning partners, and to create a Learning Partner Recommender System based on the findings, while maintaining a high level of student involvement throughout the process.

The factors found and the system built on them are the results of multiple iterations of student interviews, practical testing and feedback, concluded by an extended grouping study conducted at the University of Oslo. The results indicate an overwhelming satisfaction with the groups made by the system and suggest that a grouping on these factors creates environments conducive to developing collaborative competencies. Further, the results contribute significantly to our understanding of how to design educational pathways that foster comprehensive competence development in collaborative learning environments.

Keywords:

Matching criteria for student grouping, Learning partner recommender system

1 Introduction

Forming groups is an important part of learning, and research shows that working in groups is crucial, both in order to develop strong networks and to equip students with the collaboration skills they will need when entering the workforce (Burke, 2011, p. 87). The same research also emphasizes how active learning in a group environment can benefit students in terms of better grades and student satisfaction, as well as lowering the chance of students dropping out.

While there are clear benefits to working in groups, there are also detrimental effects associated with working in dysfunctional ones. Research indicates that subpar group formation actually demotivates students, and ultimately poses a hindrance to their learning (Cruz & Isotani, 2014, p. 207). Being able to provide students with well-functioning learning groups would therefore be of great benefit, both in terms of better learning outcomes and student satisfaction.

Following Johnson and Johnson's definition, a good group dynamic is fundamental to well-functioning groups. A well-functioning group should be able to communicate, establish leadership, make decisions and resolve conflict, through the active involvement of all group participants (Johnson & Johnson, 2008, p.29). Building such a group requires insight into the individual students, something that can be difficult to achieve in practical settings.

Groups, in higher education today, are typically built by either letting students self-select their group members or through the instructor applying whatever criteria they deem appropriate (Johnson & Johnson, 2008, p. 29). Neither of the commonly used approaches can guarantee a good group for everyone, but the options are limited. This has led to several studies centered around developing and testing new methods of group formation (recommender systems).

The existing research is considered to have brought valuable contributions to the field and has shown that there is potential for improving the experience of students through providing recommendations for suitable learning partners. Still, most of the criteria used in grouping research have been based on the researchers' own rationale or the general consensus of the current literature. Evaluation approaches to determine the quality of such systems have also often used synthetic data, with the focus being shifted towards scalability of the technology, and performance metrics (Tam Nguyen et al., 2019, p. 1103). In other words, there is a lack of research where the opinions of the target group, i.e. students, are taken into account during both the criteria selection and evaluation of the recommender system.

Similar to existing research, the aim of this paper is to determine the factors most indicative of suitable learning partners, and to create a Learning Partner Recommender System (LPRS) based on the findings. How this paper differentiates itself from the existing literature, however, is the uniquely central role that students play. In addition to being involved in the initial research and testing, students also took part in the evaluation of the LPRS, by working in groups produced by the LPRS for a whole semester and

providing feedback afterwards, as part of a study. The study was conducted in a first semester course at the Department of Informatics.

The dual nature of the paper resulted in two equally important research questions:

RQ1 - Which metrics of a student are relevant to finding suitable learning partners?

RQ2 - Would a tool, grouping students based on these metrics, be able to form groups that are preferable to semi-random ones in a practical university setting?

2 Method

The research in this paper was conducted in the form of an iterative process, where the insights gained from each iteration formed the basis for subsequent work. Following is an overview of the method.

An initial selection of six student grouping criteria (matching criteria) was formed based on existing literature and current practices. The selection consisted of:

Availability - student's available hours for group work (selection of timeslots)

Work frequency - student's desired frequency of group work (days per week)

Workload - student's desired amount of time spent on group work (hours per week)

Ambition level - student's ambitions for the course in terms of learning outcome (selection of most fitting textual description)

Preferred attendance mode - student's preference for online or in-person group work

Preferred language - student's preferred working language

Student interviews were conducted to assess the relevance of the initially selected matching criteria, and to assess the need for new matching criteria. The students interviewed were asked whether they found each criterion relevant to discerning suitable learning partners, why they found them (ir)relevant, and whether any other criteria (existing or new) would be more relevant.

A revised selection of matching criteria was formed based on the insights gained from the student interviews. The new criteria proposed during the interviews were evaluated, and the criteria that were considered irrelevant by the students were reevaluated.

The LPRS was implemented using Nettskjema (an online form) for data collection, python for data engineering, and k-means clustering for student classification. It was designed to classify students using the revised matching criteria and then split the classes into groups of four. Development testing was performed on synthetic "student" data, and the grouping logic was adjusted during testing to ensure the most similar "students" were grouped together.

A small-scale test of the LPRS was conducted on students to assess whether the grouping performed on real student data was of the same quality as the grouping performed on synthetic data.

The LPRS was improved upon, using the insights gained from the small-scale testing. Criteria with little variation, and consequently little effect on the grouping logic, were removed, in order to achieve a more relevant grouping. In addition, gender identity was added as a matching criterion to enable the creation of balanced groups.

The LPRS was used in an extended study, to provide the basis for a thorough evaluation of the quality of the grouping, and by extension the relevance of the matching criteria. The study consisted of the LPRS grouping first-year students participating in the course IN1020 at UiO, and these assigned groups working together on mandatory assignments over the course of a semester.

In-depth group interviews were conducted at the end of the study to assess whether the goals of the paper had been met. The students interviewed were asked to share their experiences with working in the LPRS-assigned groups, and to evaluate the quality of both the group environment and the group work. The feedback gained from the interviews constituted the final results of the research and provided the basis for the final evaluation.

3 Results

During the first round of student interviews, the students were asked to assess the relevance of the initially selected matching criteria. Shown below (fig. 1) is the distribution of answers to the first two questions regarding matching criteria relevance:

Q1 - "When recommending potential learning partners, could a similar answer to [matching criterion] be relevant to discerning which students might work well together?" Q2 - "In the same context, would you personally prefer someone who has a similar answer to [matching criterion] as you?"		
Matching criterion	Q1 (Yes)	Q2 (Yes)
Availability	96%	96%
Work frequency	80%	84%
Workload	32% (*)	48% (*)
Ambition level	96%	96%
Preferred attendance mode	60%	64%
Preferred language	52% (**)	52% (**)

Fig. 1: Collected answers from 25 student interviews regarding perceived matching criteria relevance. Grayed out matching criteria were not included in the final version of the LPRS.

() Answers regarding workload were ambiguous, as students considered workload to be important, but harder to estimate and less significant than work frequency.*

*(**) All students interviewed were native Norwegian speakers who considered themselves proficient in both English and Norwegian.*

During the first round of student interviews, the students were also asked to specify how relevant they personally found each of the initially selected matching criteria, and why they found the criteria (ir)relevant. Shown below (fig. 2) is a summary of the answers to the third question regarding matching criteria relevance:

Q3 - “How important is it to you that a potential learning partner has a similar answer to [matching criterion] as you do, and why?”	
Matching criterion	Notes
Availability	<ul style="list-style-type: none"> • Very important factor • Reduces logistical problems • Allows everyone to participate • Integral to allow for desired work frequency
Work frequency	<ul style="list-style-type: none"> • Very important factor • Lets you avoid having to “carry” others • Supports equal participation • Also a good indicator of ambition
Workload	<ul style="list-style-type: none"> • Mixed response • Good in theory but difficult to estimate beforehand • Work frequency and ambition level are better indicators of how much someone wants to work
Ambition level	<ul style="list-style-type: none"> • Very important factor • Best measure of how much someone wants to apply themselves • Ensures everyone is equally motivated • Common goal unifies groups
Preferred attendance mode	<ul style="list-style-type: none"> • Important factor • Some were fine with different preferences • The majority strongly preferred similar preferences and considered it a very important factor • Ensures everyone is equally involved
Preferred language	<ul style="list-style-type: none"> • Somewhat unimportant factor • Native language was generally preferred, but very few mind having to work in English • Therefore not the most relevant matching criterion

Fig. 2: Notes from student interviews regarding personal opinion on and reasoning behind matching criteria relevance. Grayed out matching criteria were not included in the final version of the LPRS.

During the group interviews at the end of study, the students were asked to share their experiences with working in the LPRS-assigned groups. Shown below (fig. 1) is the distribution of answers to two of the questions regarding satisfaction with the LPRS's grouping:

Q1 - "For group work in future courses, which of these options would you prefer?": O1 : "Working with this group" O2 : "Finding a new group"				
Q2 - "Assuming you are required to find new groups in future courses, which of these options would you prefer?": O1 : "Being grouped by an LPRS similar to the one used in this course" O2 : "Finding a group using alternative means"				
	Q1		Q2	
	O1	O2	O1	O2
Students	100%	0%	95%	5%
Groups	100%	0%	85% (*)	15% (*)

Fig. 3: Collected answers from 13 LPRS-generated groups (42 students) regarding group satisfaction. Group members were not informed of what their fellow group members answered.

() 85% of groups unanimously voted for option 1. In the remaining 15% of groups, one member voted for option 2.*

The final set of matching criteria used for student classification consisted of:

- Availability
- Work frequency
- Ambition level
- Group size
- Gender identity

4 Discussion

The findings from this research contribute significantly to our understanding of how to design educational pathways that foster comprehensive competence development, particularly in collaborative learning environments. The results not only answer our initial research questions, but also provide valuable insights into designing educational programs that enhance students' collaborative competencies.

The final set of primary matching criteria that emerged from our research - namely availability, work frequency, and ambition level - represents more than just logistical parameters. These criteria form a foundation for developing crucial workplace competencies that extend beyond mere academic knowledge and skills.

Despite being similar to ones found in the existing literature, each criterion has throughout the research been subject to numerous evaluations, not only from the perspective of existing research, but also from the perspective of the students which the criteria are intended to group. The high relevance ratings (80% - 96%) given by students to these criteria, coupled with their strong preference for groups formed using these parameters, suggests that these factors create an environment conducive to developing collaborative competencies.

The group size and gender identity as additional grouping criteria further reflects the complexity of designing learning environments that promote comprehensive competence development. These criteria acknowledge that collaborative competence isn't solely about matching schedules or ambitions; it's about creating diverse, balanced groups where students can develop the interpersonal skills and adaptability required in modern workplaces.

These findings serve to show that the final matching criteria determined through this research are both highly relevant and constitute a sufficient basis for determining suitable learning partners, answering the first research question.

As the LPRS used to group students in the extended study was built solely on the final set of matching criteria, the final evaluation of the LPRS directly connects to the second research question

The overwhelming preference (100%) of students to maintain their LPRS-assigned groups for future courses indicates that the system successfully creates environments where students can develop sustainable collaborative relationships - enhancing the learning environment. This finding is particularly significant in the context of designing educational programs that prepare students for tackling complex problems in their future careers. The high satisfaction levels suggest that these groups provide a foundation where students can develop not just subject-specific knowledge, but also the broader competencies needed for effective teamwork.

The unexpectedly high preference (95%) for being grouped by a grouping tool similar to the LPRS rather than alternative means for future courses further indicates the success of the system. Not only does it suggest a perceived lack of trust in the alternative means of grouping currently available, but it also emphasizes the necessity of an easily available and effective grouping tool, such as this system.

In conclusion, the insights gained from the final interviews clearly indicate that the LPRS built on the final matching criteria is capable of producing groups that are preferable to semi-random ones, i.e. groups formed through alternative means, answering the second research question.

Special thanks to

Miriam Schumacher Hillesund for valuable insights, and the students at the Department of Informatics for their invaluable participation in our research.

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