

Establishing a Learning Community to Support Master's Thesis Writing Students in a Problem-Based Learning Context

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Abstract

Universities practicing problem-based learning (PBL) activities as part of their educational foundation teach students to work problem oriented through group work. At Aalborg University, the students are typically divided into groups of four to seven. Though, the master's thesis is often written individually or in pairs. This study addresses the contradiction of PBL promoting a collective, group-oriented approach to teaching while the final thesis is individually or in pairs. A learning community (LC) was established among master's thesis writing students supervised by the author to complement the traditional supervision. The LC was framed as monthly research meetings with progress presentations by the students followed by discussions among the students with the supervisor present. Thus, this pedagogical intervention aims to inspire new PBL practices in environments where students primarily work on individual projects. The purpose is not to create new teams or groups, but to create a learning community among students working problem and project based on their individual projects. The students find the LC a valuable addition to their thesis year. Individual students appreciate the group feeling for discussions, while paired students use the meetings to follow up on their own work and get new inputs to their work.

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Introduction

Problem-based learning (PBL) is the root of teaching at Aalborg University, where students perform group-based studies under supervision using their creativity and skills to solve research questions, industrial problems, or a generic problem (Servant-Miklos, 2020). PBL is used to teach students to become effective collaborators through group-work (Hmelo-Silver, 2004). At the Department of Chemistry and Bioscience, Aalborg University, the number of students per project group varies greatly depending on the experience of the students and the total number per year, however typically the students are four to seven students per group. The final two semesters, most students write a so-called long thesis (nine months from September to May), which is written individually or in pairs based on experimental or computational research projects. Thus, a contradiction between group oriented PBL and individual work exists. The transformation from group members to individuals results in a significant change in their learning environment due to the missing social interdependence from the group (Shimizu et al., 2021). As an individual, the students are to maintain track of all parts of the project management such as time planning, literature reading, lab work, data analysis, and thesis writing. Meanwhile, the discussion of results and theory relies on the students' own reading and interactions between students and supervisors.

The starting point in PBL activities is a problem (de Graaff & Kolmos, 2003) which students are to solve through collaborative group work to enhance their learning outcomes (Stentoft, 2019). The project groups can be considered as small learning communities. A learning community relies on social connections and sharing of learning experiences through peer-to-peer learning (Campbell et al., 2024), however, without the necessity to solve a specific problem. Thus, students help each other understand fundamental theory in learning communities where PBL settings are used to solve a problem, however, during a project the students should help each other understand the background theory necessary to solve the problem. Both learning communities and group-oriented PBL seek to enhance the learning through active participation and student engagement. As the students start to write the master's thesis individually, the learning community from group work disappears.

Communities can be formal and informal, where PBL-based communities often are considered informal with focus on voluntary sharing and trust (Goglio et al., 2023). Learning communities are groups that work towards a common goal,

and the communities can be described in terms of access, relationship, vision, or function (West & Williams, 2017). Access requires either physical or online contact, so-called ready access (Rovai et al., 2004). Relationships rely on emotional belonging (Blanchard et al., 2011), and can be described through three different modes i) engagement (do it together), ii) imagination (reflection to see new possibilities), and iii) alignment (mutual progress) (Wenger, 1999, 2000). Vision requires a shared goal or mission in the community (West & Williams, 2017).

Here, a pedagogical intervention is introduced to overcome the contradiction in PBL-based group work and individual thesis writing. A learning community (referred to as *LC*) was organized among six master's thesis writing students establishing a knowledge-sharing group despite individual or pair work. All students were supervised by the author performing their projects individually (two students) or in pair (four students in two groups). As part of *LC*, the supervisor provided a common meeting place (access) where the students could engage in scientific discussions related to each other's projects (sharing function). *LCs* were organized monthly by the supervisor as an extra initiative to supplement supervisor meetings. The focus was on presentations by the students covering their topic, status, progress, and current problems, while the supervisor was to secure a psychologically safe culture for everyone to benefit. *LC* provides an opportunity to establish a relationship for discussions among the students as if they were a group. This is expected to provide benefits from both student and supervisor perspectives. The students are expected to benefit from a group feeling and relationships (Wichmann-Hansen et al., 2020) where they assist each other and learn through presentations, discussions, and reflections of the work by themselves and their peers (Wichmann-Hansen et al., 2020). The supervisor is expected to save time by answering general questions in plenum (Vincent, 2009; Wichmann-Hansen et al., 2020) and reduce ad-hoc supervision due to the students' common interactions. As an additional benefit, the discussions at *LC* may lead to new research ideas (Vincent, 2009).

Methodology

The establishment of a learning community was based on monthly research meetings organized as typical research meetings (Delamont & Atkinson, 2001), where the students presented their progress either individually or in pairs. However, at *LCs* there was a deeper focus on support and learning among the students rather than scientific sharing. At each *LC*, students presented their project status as well as current problems (such as experimental design, data interpretation, etc.) where they needed support from other students (or supervisor), typically 1-3 focus points. After the presentation, the focus points

were the starting point for discussion among the students, however, the students were allowed to ask questions or provide any feedback they had on the presentation.

Six master's thesis students supervised by the author evaluated LCs along with other learning activities based on two questionnaires. The author created open-ended questionnaires to gain feedback from the students on the role of different learning activities in comparison to LC. The students were identifiable to the authors as the expectations and experiences of the students were to be compared. Identifiable questionnaires were considered feasible in this study as the students were to comment on a teaching method that was developed for enhancing their own learning and not comment on their supervisor. Thus, the feedback of the students was simply to determine if LC provided a room for learning and reflection, or if the students preferred more traditional learning activities. Therefore, it is expected that the students provided their honest opinions. First, the students stated their expectations within two weeks of starting their thesis followed by a new questionnaire after approx. three months to evaluate their experiences. As part of the questionnaires, the students were to consider the following learning activities: Literature reading, Lab work, Ad-hoc supervisor assistance, Supervisor meetings (individual/pair), the learning community (LC), Research group meetings (with other professors, Postdocs, PhDs, and MSc student supervised by other professors in this group), and Daily discussions with other students. The students were then to consider in which project situations (idea generation, theoretical understanding, troubleshooting problems, experimental work, and data interpretation) they expected certain learning activities to play a key role. This was designed for the students to reflect upon their own use of the different learning activities in the project situations to provide input on connections between learning activity and project situations. In addition, the key feedback from the students has been obtained through open-ended questions such as

"What have been the main difference in your MSc work (individual/pair) compared to a typical semester project (group)? What did you gain and miss?"
and *"Have LC contributed to enhanced communication in your daily work with students within same topic?"*

These questions were asked to gain information on whether the students benefited from LC or whether it was considered waste of their time.

Results

The nine-months master's thesis writing period differs from previous student projects as the duration is longer (typical semester project 3.5-4 months) and the

students are only one or two to perform the project. This is a contradiction to the PBL-focused group work, and it is thought upon among the students. The fact that students work either individually or in pairs provides differences in their expectations for the work. As one student explained,

"I do not expect it to change much (as) I work in a two-person group" while a student working alone told "I expect that it will be more challenging, but also more rewarding, as I have to do everything by myself."

The students generally agree that they expect interaction and relationship with the supervisor will be more important due to the missing study group.

After three months the expectations were confirmed as experiences among the students were either 1) working alone they do everything alone and must prioritize between tasks or 2) as a pair they have someone for discussions, and they can distribute tasks such as writing and laboratory work. A student working individually expresses *"it feels like the laboratory work is always behind and lacking"* confirming the frustrations going from group work to being alone.

The need for a learning community

LCs were introduced to establish a community among the students, and the benefits are reflected in positive feedback on both LC and daily discussions with other students. As stated by one student *"It gives some kind of belonging, and we help each other-feeling."* As a follow up, the students were asked which learning activity they expected and experienced being most relevant for different project related activities. The students neither expected nor experienced LC as a place for discussing fundamental theory and experimental work. In contrast, they experienced it useful for troubleshooting and data interpretation compared to their expectations. The daily discussions were experienced to be a more frequent use for discussing fundamental theory, troubleshooting, and experimental work compared to their expectations. In contrast, the students experienced less discussion on data interpretation on daily basis with other students. Thus, LCs have positively provided room for discussions and know-how of each other's project resulting in engaged daily discussions.

Student thoughts on the learning community

The students had different expectations regarding the usefulness of the learning activities. Their expectations were based on their knowledge and experience as group members and thoughts on how this would change during individual or pair work. All agreed that laboratory work and supervisor assistance would be key activities for learning during their master's thesis work given the experimental nature of their projects. The effect of LCs on learning outcome was

subject to the largest disagreement among the students. The main reason for the large discrepancy is the fact that some students write individually and others in pairs. Furthermore, the students were skeptical about LC and the daily discussions emphasized by statements such as

"None of the others are working on the same subject" and "the knowledge of students compared to supervisor(s) are limited."

Despite this, the same student expressed positive thoughts on LCs after three months:

"Sometimes the other MSc students have come with productive ideas, and I can only imagine it has an even greater impact on those who work alone,"

and the student stated that the LCs had been the foundation for daily interactions with other students as a result of the knowledge obtained on each other's projects. The student expressing skepticism about the necessity of the LC argues for the students provide their honest opinions in the questionnaires despite being identifiable. A student working in a pair stated that they would rank the LCs higher if working individually as this allows for discussions with peers. Another student working individually told:

"I learn a lot from discussing the problem with others. I have also experienced that people who don't work with the same problem as me can provide other aspects which can be useful."

Thus, LC has acted as a foundation for discussions and interactions among the students and the students feel comfortable in asking for help because they know that the other students have pre-knowledge which enhances their changes of helping.

Focusing on LCs and daily discussions among the students, these learning activities were considered important in different phases of the project by the students. Students state that they expect or hope to receive new perspectives and ideas on their project from other students during daily discussions or at LCs. After three months, more students found LCs more useful in troubleshooting and data interpretation than expected based on the continuous presentations of the projects and thereby knowledge of the projects. This also led to daily discussions where the students helped each other in understanding relevant theory. The students also started assisting other students in the laboratory with analytical equipment or experimental design. As an example, students from two different projects that were rather different found a mutual angle to discuss design of temperature profiles of experiments.

Learning community – from a supervisor perspective

A few key points were listed as expected positive outcomes from a supervisor perspective. The opportunity to answer common questions in plenum was also experienced following different literature (Vincent, 2009; Wichmann-Hansen et al., 2020). However, some questions were also discussed during supervisor meetings with individuals or pairs, thus, a few duplicate discussions occurred. This may need to be highlighted to the students that non-urgent, general questions should be discussed during LCs to save time. While LC was added as a supplement to ordinary supervisor meetings, a successful implementation of LCs would most likely save time for the supervisor. This has also been observed in this study by a reduced number of ad-hoc meetings.

Discussion

Problem based learning at Aalborg University is introduced through project-oriented group work, however, how are students affected when writing a master's thesis individually or in pairs? In this pedagogical intervention, master's thesis writing students supervised by the author were introduced to several learning activities with a key focus on an established learning community (LC). Based on feedback from the students as well as observing their engagement in discussions, the students need a psychological safe room illustrated by two things; 1) the students needed a few LC meetings to become familiar with each other's projects and be safe in asking questions to their fellow students, and 2) the students were less engaged during research group meetings with other professors, PhD students, postdoctoral researchers, and other MSc students. This was confirmed by students stating,

"The meetings with other MSc students (LCs) seem to offer better learning, as they create a debate with the other students, who through several meetings have a better knowledge of the project and the issues that have arisen."

LC meetings had a focus on learning rather than presented research. An approach to enhancing the discussions at earlier stage of the process could be to have an open first LC where the students could be curious about each other's projects rather than solving issues. This way the students become more confident with all projects. In addition, the framing of the LC potentially needs to be presented better by the supervisor: what is expected from the students? What are they supposed and allowed to do during LCs?

The students were asked to include few (1-3) current issues by the supervisor. However, the issues became too project specific rather than a starting point for discussions. The students found it difficult to phrase relevant issues for two reasons 1) some already discussed them with the supervisor and 2) the issues

were project specific and required background knowledge. However, one student was positive stating

"I believe it have been beneficial as there often is issues that can be at least partially solved by getting other people to look at one's work."

For the future the first meetings should potentially be performed differently, so what could be changed to have the students engaged in discussions? Rather than taking a passive role as supervisor, the supervisor should set a good example (Rosen et al., 2007) teaching the students how to ask open-ended questions starting discussions. Examples:

- What was the key takeaway from presentations (from the listeners' point of view)?
- Do peers have any questions regarding the project itself?

Asking the other students about the key takeaway will show if the presenter had the right (expected) focus in the presentation and showcase any potential misunderstandings. Thus, this could allow for learning in presentations and start the discussions on multiple levels from overall project objective to fundamental scientific understanding of results or methodologies.

Conclusions and reflections

To overcome the individual PBL work and feeling of being alone, a learning community (LC) among six master's thesis students of a single supervisor (the author) was introduced. LC was organized to introduce a group-feeling to enhance the daily scientific discussions and assistance among the students. LC was found to provide a safe space for discussions; however, an initial barrier exists as a mixture of psychological insecurity and insufficient knowledge of each other's projects. Overcoming this barrier leads to discussions and reflections among the students both at LCs and in their daily activities shown by enhanced engagement at LC meetings. The students find LC a great supplement to traditional supervisor meetings, however, in the future LC should substitute either supervisor meetings or ad-hoc supervision to not extend the supervision time. Interestingly, the students use LCs in two different ways depending on whether they work individually or as a pair. Individually working students found a group feeling and room for discussion, while the students working in pairs greatly benefited from continuous reflections on their progress. Thus, the knowledge of each other's projects allowed for daily assistance and discussions.

Considering the four terms used to describe learning communities (West & Williams, 2017), LCs have provided access to a joint room for students sharing a function and it built a relationship between the students. The students all agree that the LCs provided the feeling of being part of a group. The students have illuminated the similarities in their projects resulting in safe discussions on the projects daily outside the LC. Generally, the students have worked more closely with others than in previous projects for at least two reasons: 1) the LCs provided the opportunity to become familiar with each other's projects, and 2) the students required discussions with others for feedback.

Further improvements to the established LC can include thematic meetings for students to focus on *data visualization* or the *oral presentation* with an emphasis on use of body language, slides, or showcasing physical samples. A couple of focus areas as supervisor could be:

- *How to enhance learning from the student presentations?* The students should teach peers about their project rather than only expecting assistance. This leads to a mutual process towards higher goals following Etienne Wenger's thoughts on alignment (Wenger, 2000).
- *How to teach the students to think academically in their questions?* The students should be taught how to reflect on their own knowledge and set that in play for curious and critical questions.

This pedagogical intervention aimed at inspiring a new PBL practice for individually working students to create a learning community for discussions rather than forming teams for same project. It is expected that the establishment of learning communities can be extended not only to other technical and natural science educations, but also to social science and humanities studies.

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