# Supporting collaborative learning by scaffolded meetings in the university programming courses

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**SUMMARY**

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Hundreds of students sign up for programming courses in the hopes of getting credits on their certificates and an advantage in the job market. However, the pass rate for the course that challenges perseverance varies between 52% and 69%. This study presents information about collaboration advantages and challenges in an undergraduate programming course. Groups were supported by the six scaffolded meetings to tackle the dropout rates.

In autumn 2022 nine groups were formed from the university students to perform programming course using collaborative learning approach. Programming course lasted for 14 weeks and included 11 demo assignments and project. During the six scaffolded meetings data was collected and then analysed using qualitative data-driven analysis.

Students experienced several advantages and challenges even scaffolded meetings were constructed to support collaboration. Collaboration gave peer-support and relationship level support for the students. Students experienced scaffolded meetings helpful, but they would still have needed more help to interaction and to shared acknowledge.

More research is needed about collaborative learning in the university context. Results indicate that university students need support and guidance how to work collaboratively. Collaborative skills are needed at all levels of education and in working life.

Keywords: collaborative learning, scaffolded meetings, engagement, interaction

**CONTENTS**

# 1 INTRODUCTION

Human is a social being and our society works through interaction. Collaboration is needed in all the dimensions of our lives. Learning is also social process according to Bandura (1969) and collaborative learning gives opportunities to learn and solve problems together.

Programming courses in university is considered laborious and difficult. Hundreds of students sign up for programming 1 and programming 2 hoping that it will give head start for working life. Perseverance is challenged by the long duration of the course, the amount of work and the large syllabus.

Low pass percentages and the nature of the course motivated to study whether collaborative approach could help to tackle the dropouts. University students from programming course were given opportunity to perform programming course in collaboration. Nine groups from programming 1 and programming 2 were formed. Based on the interviews of the spring 2022 implementation, the students needed support for collaboration.

Support was given in form of six scaffolded meetings, which were constructed to support collaboration. Scaffolded meetings included grouping, forming the rules of collaboration, joint discussions and reflection. I, as participating research, provided research information about nature of collaboration and what are the conditions for successful collaboration.

Data was collected during these six scaffolded meetings from the discussions and from survey at the end of the collaboration. Discussions and reflections during the scaffolded meetings give information about advantages and challenges for 14 weeks collaboration in university programming courses. Survey in the end of the course, provided information how students experienced scaffolded meetings as a part of their collaboration. Study used qualitative methods to answer research questions about advantages, challenges and students' experiences about scaffolded meetings. Study used also quantitative methods to construct more comprehensive understanding about the phenomena. Qualitative methods were used to reflect pass percentages and number of course participants.

This study gave interesting information about the importance of collaboration skills. Students experienced that they have good collaboration skills, but study reveal that university students need teaching for collaboration. Collaboration skills are needed in all educational levels and in working life.

# 2 SOCIAL CONSTRUCTIVE LEARNING

Human is a social being. Many phenomena manifest through interaction and learning is one of them. Already in 1978 Vygotsky argued how human beings are based on interaction and how full cognitive development demands for social interaction, where language is the key element. By this social interaction he means action between people when they talk to each other's.

Social interaction works as a tool to learning. Social theory of learning focuses on the social nature of learning. Social nature is understood as interaction and collaborative activities. In the context of learning, interaction is interpreted as participating in conversation, problem-solving and collaborative tasks. These collaborative tasks help students to build their own understanding of concepts and ideas.

Learning is a social process where people learn from each other through communication. According to Bandura (1969), people learn from other people by observing and modelling. People observe others and imitate how they perform or behave in certain situations. Other people work as a role model to the learner and through communication give feedback. This process of learning through observation, is used as a core to teach. In school, e.g., in mathematics, the teacher shows where the numbers come from, what step folding is performed and how to calculate. This process also occurs in peer learning. One student shows and others observe and imitate.

During learning, several processes work top of each other and overlapping. Constructivism is related to social learning with its constructive nature. Constructivism argues that knowledge is constructed. New information is combined with old information and learning is based on this process. Driscoll (2014) describes that this construction of knowledge is a process in which learner transfers knowledge from the outside into the learner. Whereas Larochelle & Bednarz (2010) sees knowledge construction as way to encourage students to greater participation in learning. Learning is active process, which demands participation.

Social learning is active and requires participation. Participation and engagement towards task level and relationship level communication. Lave (1988) summarizes social theory of learning setting cognitive engagement in the core of human learning. For learning to happen, people must be engaged to certain activities with certain people and being actively participate to their action (Wenger, 2009, 210). Therefor Vygotsky (1978) emphasizes, that people around learner foster thinking and enables intellectual growth including growth in knowledge and understanding. Knowledge and understanding are developed between people through interaction. To get group of people and individuals learn socially, they need to engage, act and agency in the group.

Although social constructive learning emphasizes social activity, learning is also activity within the learner. As mentioned earlier knowledge is constructed together and for that to happen, learners must participate to learning process by sharing their individual perspectives. After this shared knowledge building starts individual assimilation (Pritchard & Woollard, 2010), where learner incorporates new information into cognitive structures or mental models. Assimilation helps individuals to make sense of new experiences and to make connections between new information and prior information (Driscoll, 2014).

Social learning can be viewed through different dimensions. Many resent studies have focused to social learning from the collaboration perspective. Researchers have constructed their own dimensions to study social learning. Wenger (2009) shared social learning to four dimensions; meaning, practice, community and identity, whereas Vrieling-Teunter, Vermeulen and de Vreugd (2022) moved more collaborative and interactional direction, using components as practice, domain and value creation, collective identity and organization. Dimension names differ but the meanings are mostly the same.

Wenger´s (2009) meaning and Vrieling-Teunter et al. (2022) domain and value creation can be seen as experience. Meaning as ability to experience world and engage to it as meaningful matter. This can be manifest from how people talk about their abilities as individual and collaboratively. (Wenger, 2009, 211.)

Whereas Vrieling-Teunter et al. (2022) refer to as the sharing of expertise and experience among group members. Reflection is one way to meanmaking and to become aware of one's abilities and experiences. Sometimes learning is not experienced consciously but it happens unconsciously, informally. In collaborative learning the main focus is on learning and problem solving but through collaborative working student learn other things as well, like social interaction skills, scheduling and communication.

Second dimension is about practice and is viewed as operational level. It´s about doing and those actions that can sustain mutual engagement. It manifests how people talk about shared past and social resources, framework and perspectives. (Wenger, 2009, 211.) It is also about agreed rules, timetable, deadlines and all those things that enables action. In the context of collaborative learning, it includes everything from planning to actions. However, practise refers to action, Vrieling-Teunter et al. (2022) indicates that relationship between the people who are learning, is necessity. Their practise dimension includes both action and relationship.

Wenger´s (2009) third and fourth dimension, community and identity refers to belonging to a group and how learning chances who we are. Everyone is part of dozens of groups during their lifetime. Communities are seen as different groups, like family, classroom, workplace or hobbies. This manifest in how we talk about social structures, define what is worth of pursuing and interpreting what we are doing. Learning as belonging is also about what are the communities that we feel we are part of and with or without that we have our name on the participation list. Learning as becoming examines how learning creates personal history in the context of communities. (Wenger, 2009.) University students does this identity work through their studies. They first start as novice and after many years of training become experts.

Vrieling-Teunter et al. (2022) defines third and fourth dimensions as collective identity and organization. They demonstrate collective identity as group members working interdependently with common purpose and responsibility

for collective success. Organization is about groups degree of autonomy, connection to people outside the group, equality and agreed rules of autonomy.

Wenger (2009) also talks about how we need to rethink learning. When the focus is on the participation, we need to understand what it takes to understand and support learning. From individual level it means engaging to the community and contributing community practices. From community level it´s about refining practices and knowing what the community knows. (Wenger, 2009.)

This all comes back to learnings social dimension. All the previously mentioned dimensions are interconnected and interactive. And as viewed from individual or community perspective, we need other people around to enable learning. Collaborative learning is a learning approach, where people learn together with shared goal.

## 2.1 Collaborative learning

Collaborative learning is one way to implement social learning. Social learning is active learning, which means participation and engagement to learning and group activities. Collaboration can be seen as a process where two or more people work together to achieve a pre-defined goal. Dillenbourg (1999) gives the most used definition to the concept, that it's a situation where a group of people learn or try to learn something together.

Collaborative learning (CL) is a learning approach facilitated by the instructor. It's many times used as a synonym to cooperation, and they do have many similarities, but they are not the same. Both include cooperation, members two or more and they have the same goal. Difference comes from the facts that collaboration is contemporaneity (Palincsar & Herrenkohl, 2002), there is a positive dependency relationship, promoting interaction (Pritchard & Woollard, 2010) and individual and all members work towards a shared goal without competition (Laal & Ghodsi, 2011).

Maybe the easiest way to understand the difference between cooperation and collaboration is related to task performance. In cooperation, students usually

divide the task into smaller parts and share the responsibilities. At the end, members gather the smaller parts together as a whole, presents the work and returns the paper to the teacher. But in collaboration, the hole task is performed together in synchrony. Members knowledge works as a resource for the group. Working process is in the core, not the result, as in cooperation.

Collaboration is more long-term and intensive than cooperation and members working together influence each other's work and solve the same problem. In collaboration, members have the same goal and activities that require time, responsibility, and trust. (Pritchard & Woollard, 2010.) Palincsar & Herrenkohl (2002) defines that all the members work with same task, at the same time and share cognitive responsibility about the task. Cognitive responsibility can be observed through doing (skills), showing (skills), telling (knowledge) and explaining (understanding) (Pritchard & Woollard, 2010).

Collaboration can be viewed from situation perspective. In collaboration situation group of people have the same, shared objective, which is problem solving. Group needs to negotiate about their objectives so that they have shared understanding where they are going, how and why. At the core of the collaboration is a problem solving.

Collaboration can be viewed as symmetric collaboration. Symmetric collaboration is working at the same time, the same task and as equal. Collaboration is divided by the Dillenbourg (1999) in three dimensions: action, knowledge and status. Symmetrical action meaning every group member has the same right and duty to work to solve the problem at hand. Students try to learn and solve the problem at the same time, constructing shared understanding.

Second dimension is knowledge symmetry. This dimension can also be called as symmetry of skills and development. All the members have the same premise about knowledge, skills or development. Group members do not need to be in the same level but the opportunities for equality must exist. Everyone has the same information and together they reflect and construct knowledge. The ideal situation in knowledge construction is that when one begins and other continues from where the first reached in problem solving.

Third symmetry dimension is status. The nature of collaborative learning includes long-term and intensive work, which affects the fact that the group forms its own community during the work. All actors in the group have the same position in relation to this community. This means being heard, power and the amount of participation.

Status connects to other dimensions of symmetry as a conditional factor. Humans act unpredictably in the midst of uncertainty. If the activity between all group members is not balanced or the development does not progress at the same level, the status cannot be balanced. Discussion to achieve a balance of action, knowledge and status helps. Even if the skills are of different levels, it does not mean that participation and status cannot be achieved by being aware of the group's structures. In a group, naturally changing roles as explainer and listener helps to find a balance between members.

Collaborative learning is about interaction. Collaborative learning is an opportunity to share ideas and to develop which concludes to learning. Negotiability relates interaction to learning. By telling and explaining students can share their ideas and diversity of views can enable students to change their thinking (Syh-Jong, 2007). By telling and explaining students must defend their own view or except other´s views. Working and learning together involves argumentation, reasoning and negotiation (Dillenbourg, 1999). Faced with the problem, students start to dig up previously learned information about the subject. They make suggestions how to proceed. Students ask for reasoning and notice gaps in the explanation. This negotiation starts shared knowledge construction. Through this continuous telling and explaining process student create shared understanding and they became active learners. Like Teubert (2010) concreates, discourse is intentional acting where all the voiced ideas become as part of constructed meaning.

Interaction cannot be spoken without mentioning about language. Communication can be implemented verbally or non-verbally and they both communicate as much information. Here I speak about verbal communication, in spoken

and written form. Verbal communication is a tool to execute collaboration. Language and communication enable to share and chance information, to plan, set and share goals, proceed problem-solving and construct mutual understanding. Dillenbourg (1999) speaks about language and communication as a tool to create shared workspace, also known as grounding. By communicating students define shared situation and interaction.

Interaction in collaborative problem-solving and learning should involve interaction structures that promote high level questions and learning (Dillenbourgh, 1999). Based on Khanlari, Resendes, Zhu & Scardamalia (2017) research, asking questions, in collaborative knowledge building, engages student in more sustainable, progressive, and productive discussions, than collaboration without questions. They didn´t find significant difference whether questions were factual (who, what, where, when) or explanatory (why, how), which refers that nature of questions constructing productive knowledge building, depends on the topic being discussed. Sinha et al. (2015) found that cognitive and conceptual-to-consequential interaction are required for explaining high quality engagement.

Asking questions in collaborative learning provides several benefits. It invites students to interact which includes interactivity, synchronicity and negotiability, it transfers students from passive knowledge acquisition to active knowledge construction, develop discourse and discussion, helps students regulate their self-understanding and learning, helps control and ownership to learning and can improve interest in learning and motivation (Khanlari et al., 2017).

As mentioned earlier, collaborative learning is a process. Process has a beginning, middle and end. To enable effective collaboration beginning is a meaningful point. Palincsar & Herrenkohl (2002) says that collaboration is connected to support of interactive models, nature of the problem and creation of share social context. Interactive models are methods that support engagement to find shared environment where to construct shared understanding. In practice they are methods that support interaction like regular meetings, communication channels and action. In general, it´s about rules. It answers to questions about how the group works.

Collaboration is connected to learning which naturally places it in school environment because learning most frequently manifests in schools. Lemmetty & Collin (2020) reminds that learning is a process that happens also in work context and can be studied with group development in work practices. Higher education prepares students for the future working life. Recently, there has been growing interest about collaborative learning in higher education.

Problem solving is a huge part of collaboration. Nature of the problem influences the building of the meaning and to the promotion of consensus opportunities (Palincsar & Herrenkohl, 2002). Problem should motivate members to take cognitive responsibility about the task. Cockrell, Caplow & Donaldson (2000) found in their study that core theme of problem-based learning is ownership of knowledge, which can be embedded to three subthemes: group dynamics, tutor feedback and metacognitive awareness.

Creation of shared social context is mostly connected to aspect of process. In ways it´s a process to create shares social world (Palincsar & Herrenkohl, 2002). Social world is about structures. Is a collective way to speak and work and about shared culture. Mutual evaluation and reflection throughout the working helps the members of learning community to construct shared social context.

This research examines collaborative learning in small groups that work either as close working or remotely. The key elements of collaborative learning are defined in this study a.) mutual positive dependence of the members of the learning community b.) synchronous c.) promoting interaction d.) shared understanding between learners e.) shared responsibility for community work f.) commitment to the community and its activities g.) mutual active interaction of the members of the learning community h.) utilization of teamwork skills i.) building a joint effort j.) utilization of individuals knowledge and skills as a resource of the learning community and k.) evaluation and reflection.

## 2.2 Collaborative learning and computer-supported collaborative learning

Collaborative learning has increased interest in educational research, especially in higher education. Research results are encouraging higher educational institutions to integrate collaborative learning in their curriculum, because it influences positively to students' academic development. Collaborative learning has many benefits, but it has its own challenges as well.

Active learning is a way to successful collaborative learning. Qureshi, Khaskheli, Qureshi, Raza & Yousufi (2021) studied higher education students collaborative learning with social factors. They found that interaction between peers and teacher, social presence and use of social media affected positively to active collaborative learning and to students' participation. Active collaborative learning and participation was connected to their learning performance. Results indicated that active collaborative learning positively and significantly relates to student engagement (Qureshi et al., 2021). This research constructs a very positive image of collaborative learning and leaves out the challenges, like lack of collaborative skills, competence status and free-riding. (Le, Janssen & Wubbels, 2018).

Collaborative learning has challenges like every other learning approach. Le et al. (2018) studied higher education students and teachers with collaborative learning, focusing on the challenges they faced. Four common challenges with students to collaboration were lack of collaboration skills, competence status, free-riding and friendship. They also found three antecedents which helps to explain the identified challenges, goal setting, providing instruction for collaborative skills and assessing students' collaboration. The antecedents were related to teachers focus on the cognitive aspect of CL, which made the participations to neglect the collaborative aspect of Cl. (Le et al., 2018.) These antecedents manifested in ways teachers set collaborative learning goals. This study gives interesting information to both student and teacher aspect.

The possibility of computer-supported collaborative learning has generated wide interest in the field of education. Computer-supported collaborative learning (CSCL) studies how people learn in groups using the computer as a tool to collaboration. Lämsä (2020) researched CSCL in the context of scaffolded inquiry with temporal analysis. He found that temporal analysis answers well to the question how learning happens. Lämsä´s (2020) results support the idea, that mutual meanmaking supports learning.

Consequently, to Lämsä´s research, Saqr & López-Pernas (2023) studied why and when sequences matter in online problem-based learning. They found that high cognitive interaction kindled high cognitive interactions with others. Oppositely, low cognitive and social interaction initiated low cognitive interactions. Knowledge of interaction has great importance in teaching and facilitating collaborative learning. Saqr & López (2023) also showed that order and sequence of interaction showed highest association with performance. Therefore, it is important to study the initial stage of collaboration.

The study of computer supported collaborative learning has become an important aspect of collaboration. Zheng, Long, Niu & Zhong (2023) studied college students with collaborative knowledge building, group performance, socially shared regulation and cognitive load. They found that learning engagement, group performance, collaborative knowledge building and socially shared regulation significantly improved when groups had automated group learning engagement analysis and feedback related to it. However, the cognitive load of students who had more activities, analysis and feedback, did not increase.

Recently, interest in learning engagement has increased in the CSCL field. Individual engagement is a familiar research aim in education, but only few studies have been made about group learning engagement in CSCL. Group learning engagement is a multidimensional and dynamic process. Sinha, Rogat, Adams-Wiggins and Hmelo-Silver (2015) suggest that group learning engagement includes social, behavioural, cognitive and conceptual-to-consequential engagement and they all are highly interrelated. Whereas Fredricks, Wang, Linn,

Hofkens, Sung, Parr &Allerton (2016) argued that learning engagement includes emotional, social, behavioural and cognitive engagement.

Biansutti & Frate (2018) agreed about behavioural, emotional and social engagement but emphasized the importance of group metacognition. They argued that group learning engagement is collective engagement, which manifest as participation to learning activities. Individual learning engagement is behind the group learning engagement.

# 3 SCAFFOLDED MEETINGS

Like I earlier wrote, Vygotsky said already in 1978, that human beings are based on interaction and Wenger (2009) added, that learning is social participation. Working as a group or a team promotes collaboration and interaction skills (Pöysä-Tarhonen & Tarhonen, 2016). From these arguments is easy to understand that it is not quite the same, what kind of and how interaction is implemented.

Using collaborative learning as a learning method requires interaction from hole group. Interaction that is effective and expedient. In the next chapters I´m going to describe group development and how interaction skills are connected to group work. After that I characterize how remote working affects to facilitating of higher education students' collaboration.

## 3.1 Collaborative working

Working in groups is versatile learning approach and it has many benefits. Benefits such as task delegation, sharing responsibilities, support, diversity of ideas, and combining skills. From the benefit, it can be concluded that great results can be achieved with the help of group work.

Working in groups is productive learning approach. However, it challenges group members in multiple ways to be successful. It includes steps and dimensions that needs to be considered. There are many stumbling blocks and pitfalls to drop into. Teacher needs to identify these steps and stumbling blocks. After identification it becomes easier to plan the teaching, assignments, and collaboration. However, the most important thing is to verbalize the challenges to students so that they can approach them more easily.

In the field of research, several different models have emerged to categorize dimensions related to group work. The most used and perhaps simplest model divides group work into task and relational level. Task level including elements

like sharing and asking information, defining goals and objectives, planning, coordinating action, scheduling, reporting, and evaluation. These elements focus on concrete and efficient execution of the task.

Collaboration is not only about tasks. Tasks level plays a significant role in collaboration and it helps to achieve goal, but at least an equal role is played from the perspective of working on a relational level. In interpersonal communication, relational level is understood to encompass messages related to interaction and attitudes. These messages pertain to interest, trust, satisfaction, as well as expressions of support and care. At first the students can be unknown to each other, but as the work and collaboration progresses, the level of relationships within the group also improves.

Scott-Ladd & Chan (2008) studied higher education students' teamwork from the perspectives of relational dynamics and conflicts. Their results indicate, that when students are taught to control group processes and take greater ownership of managing conflict and team relations, they report less conflict and less social loafing. Students were also more satisfied with their learning outcomes. These results highlight the importance of the teacher´s role. For the students to be able to identify the factors that affect collaboration, they must have this information. The steps and the progress of the process must be possessed before students can control it.

Different models about group development and groups lifespan have constructed. Models use different words and concepts to describe different stages, but they all agree that task function and relationships between group members improve with the progress of the work (Tuckman & Jensen, 1977; Zurcher, 1969; Dunphy, 1968). I apply Tuckman´s five stage model. I will use it as a background and apply it. Model helps to understand that group work is a dynamic process, that develop as the members work together.

Tuckman & Jensen (1977) described small groups development according to five progressing stages: forming, storming, norming, performing and adjourning. These stages progress stage by stage. At the same time groups task level on the x-axle and relationships between group members on the y-axle improve so,

that at the adjourning stage task performance and interdependence between group members are at highest level. Development is a temporal concept, and it differs between groups.

Considering all the stages and challenges behind them, I familiarized myself with different tasks to overcome these challenges. First is grouping. Students need time and tasks designed to familiarize them with each other. Task based working doesn´t give space to relational level. Students need time and possibility to get to each other. (Pöysä-Tarhonen & Tarhonen, 2016.) Thompson (2009) studied interdisciplinary research teams and found that teams need to make social time for the team to build trust, but also to enable informal interaction. Idea could be crystallized: more you meet, more you connect.

Collaborative tasks and structure should increase interaction and make getting know each other easier. The moment is not necessarily always the best possible one for socializing and being active. People come to meetings from different life situations and sometimes the day can be the worst possible. Fiilis kierros is an easy and quick way to communicate how one is feeling upon entering a meeting. In Fiilis kierros, each person takes turns sharing about their day and how they´re doing with the group work.

As time passes and group members become familiar each other, they can recognize each other´s strengths. Bringing positive aspects such as strengths to the forefront enhances the groups positive atmosphere. Kehu Pystyyn!- round is activity that highlights things we appreciate about each other. The idea is that each person takes turns first complementing the entire group, then themselves and finally, another member of the group (Summa & Tuominen, 2009). This process continues until all members of the group have been acknowledged.

People value different things in group work. When the values are shared, it is easier to work together. Rules help groups to construct functional ways to work. Rules can be conscious or unconscious, spoken or unspoken between group members. To maintain effective and appropriate working and to prevent conflict, group needs to construct shared rules to guide mutual functions and interaction situations (Salminen, 2017, 91-92).

Scott-Ladd & Chan (2008) found in their research a high correlation between teamwork satisfaction and having group rules, but on the other hand Drusksat & Kayes (2000) found that exact task level rules can reduce team learning. According to these results, rules should guide interaction, not actual learning activities. Rules about interaction help members to know what kind of behaviour and action they are expected to perform in the group.

## 3.2 Interaction skills

Universities use collaborative approach to guide students to work in a group or team for future working life. Interaction is the core to collaboration. Students are put into groups and asked to work together. There are different research results from uninstructed group work, but Druksat & Kayes (2000) stated that it usually creates more frustration and dislike of teamwork, than great experience of working together.

Frustration and dislike towards group work can stem from various factors, factors like previous negative experiences, problems with communication or scheduling and time constraints. Often, group work focuses more on task level practices than in interpersonal relations. A typical starting point for group work is that all students have the same materials and tasks needed to complete the assignment, but no one provides guidance on how to work as a group.

Discourse about future work life is all about problem solving, critical thinking, collaboration and interaction. These factors are constructing ideology which everybody knows, but nobody knows what they mean and how to implement it. Students don´t know how interaction is being conceptualized or what is related to collaboration, but they are expected to perform them.

Interaction is generally defined as verbal, nonverbal or written communication. Everybody can communicate, but what kind of communication is appropriate and effective, is harder to implement. Working and learning together is based on communication. Communication is the mainstay to everything.

Competent communicator needs several qualities and purposes. Horila´s (2019) definition is comprehensive and says that communication competence includes knowledge, motivation, the right attitude and skills and is effective and appropriate. Other definitions in literature are parallel but include different combinations of Horilas definition. Backlund & Morreale (2015) defines communication competence as appropriate in each context, effective to achieve goals and intentional.

Knowledge in communication competence is knowing how to communicate, what are the features, how to implement them in practice, norms of situation and relations and being conscious of other people in interaction. Skills are seen as skills to motivate others, to give feedback, setting goals and achieving them but also skill to regulate emotions. Competent communicator has the right attitude and is motivated towards task and people working with.

When group of people work together, work is dominated by the spoken and unspoken norms. When norms are unspoken and shared, people don't know about them until they broke them. Competent communicator has knowledge about the norms in situation and between relations and acts ethically respectful way. Google made research what kind of qualities effective teams have. Two meaningful factors arise up, effective teams had made rules for the working, and they had psychological safety. To mirror the characteristics of a skilled communicator and Google´s research, it seems that a team or group starting out must first build rules for working to be skilled and effective in collaboration.

Negotiation is important part of interaction. Communication and decision-making in group happens through constant negotiation. Group members indicate their ideas and negotiate how to integrate ideas together. This circle of argumentation and reasoning construct shared knowledge and shared understanding (Dillenbourgh, 1999) which is the core of collaboration.

Negotiation between group members is a way to construct shared understanding. Group members start their negotiation by agreeing on timetable and task related factors. As the project proceeds, the negotiation moves from the larger entities to smaller details.

Communication and negotiation enable evaluation and feedback. Effective and appropriate team evaluate their work through the process and develop functional operating models to reach their goal. Feedback is a part of evaluation. Members evaluate themselves but also each other. There are different ways to give feedback. Constructive feedback for the future is a good way to keep interpersonal and task functions in good shape. Constructive feedback is initiative for discussion and is detailed, inspiring (Berlin, 2008), contains suggestions and arguments (Lepschy, 2008) and applied to the work done and not to the person (Touhonen, 2022).

## 3.3 Remote scaffolded meetings

In remote collaborative instructor has a huge part. In remote collaboration, natural communication is easily lost, because it´s easy for everyone to hidden behind black screens. Instructor needs to take facilitators role and facilitate participants to participate. Facilitator encourages to open communication and to camera use.

I will use definition instructor here because in the principals of andragogy, the instructor acts as a facilitator of learning and does not implement a direct transfer of information from the teacher to the student (Knowles, Holton III & Swanson, 2015).

Like I mentioned, instructor has a huge part in remote collaborative guiding. Instructor needs to get group together and help them start working. Implementing guiding remotely takes interaction to a next level. Different things must be considered in remote guiding than in face-to-face guiding. There are some similarities, but action needs more effort. The things done in face-to-face guiding applied in remote demands more energy.

In remote collaborative working structures must be such that they support interaction and collaboration. Two factors emerge from the literature, task structures and interaction structures (Dillenbourg, 1999; Tuckman & Jensen, 1977; Horila, 2019). Task structure must promote students' interdependence (Dillenbourg,

1999) and encourage to utilize the different competence of the group. Garrison, Anderson & Archer (2000) developed model, community of inquiry -model (CoI), which focuses on three dimensions of presence in remote collaboration. First dimension is about cognitive presence and task. Task problem should trigger active discussion and knowledge construction. Members explore and share information. New ideas are integrated and implemented. All this requires, that the information is available for everyone.

Second level, interaction level, should promote communication. Research has found several promoting factors like sharing and passing on information, asking high level questions and constructing explanation (Dillenbourg, 1999), inquiry and advocacy, positive and negative atmosphere, connection between groups members and to others outside the group (Pöysä-Tarhonen & Tarhonen, 2016), feeling of community and social presence (Garrison et al., 2000).

Garrison et al. (2000) models second dimension, social presence, expanded interaction to emotions, open communication and group cohesion. They emphasized, that interaction in remote collaboration is not enough. Quality of interaction plays important role. Members should bring themselves socially and emotionally "real" through the communication medium used.

Structures should also promote informal communication, such as talking about weekend activities, hobbies and coping. Informal communication advances constructing group cohesion, safety atmosphere and psychological trust. CoI-models (Garrison et al., 2000) third dimension, which is about teaching presence, emphasis teacher's role as facilitator of teaching management and building understanding.

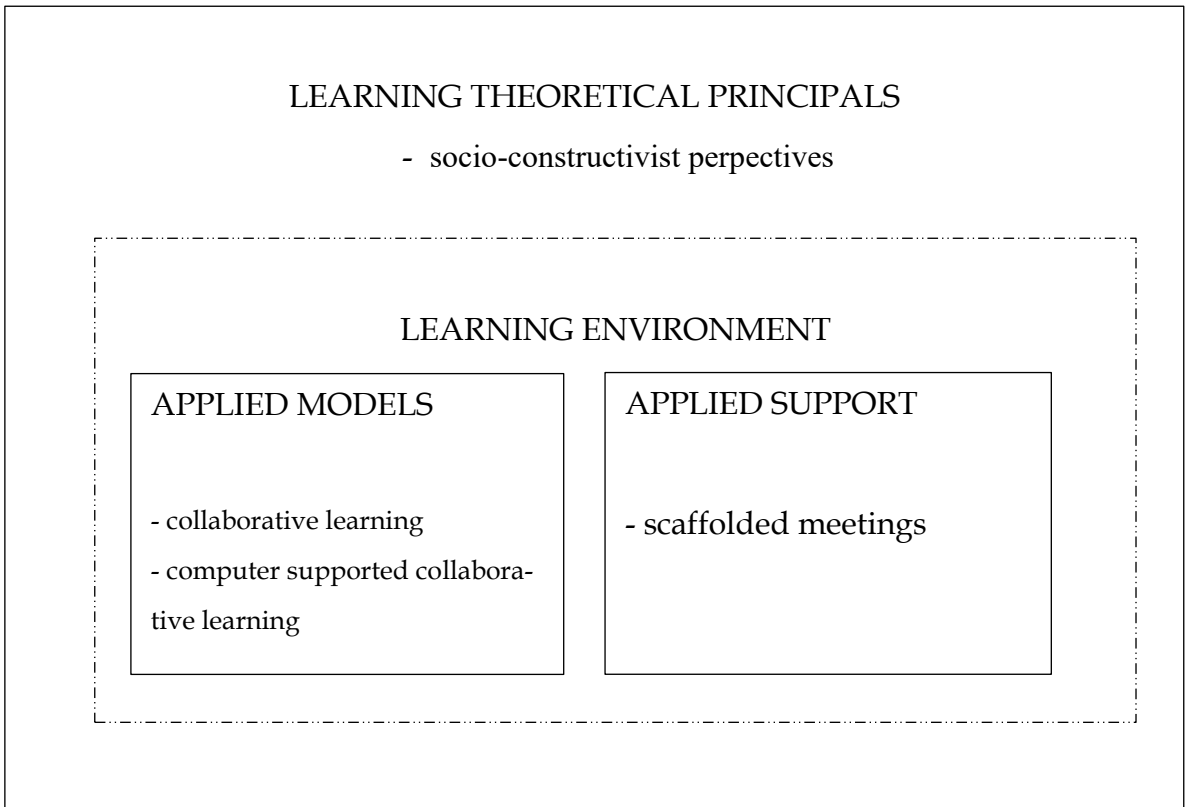
There are different tools to assist these levels. Task level needs tools that help to store information, is available to all group members and makes communication easy. Interactions level tools should promote rich interaction in remote working environments enable synchronous and asynchronous communication, various hints in communication, language variability and socio-emotional expression (Dillenbourg, 1999).

# 4 RESEARCH OBJECTIVE OF COLLABORATIVE LEARNING

This study was conducted to investigate collaborative learning implemented as a learning method in programming courses at the higher education. In the field of programming, it is generally known that there is an issue where hundreds of students register for courses, but a significant portion of them does not complete the courses. In this study, scaffolded collaborative learning is an attempt to engage students in the course. Purpose of this study is to find out students' experiences about scaffolded collaborative learning in the context of programming.

The theoretical framework and research themes of this study are summarized in FIGURE 1. Collaborative learning is approached qualitatively, utilizing content analysis as the research method. Content analysis is used to examine students´ experiences related to the phenomena in the research questions. As kind of hypothetical assumption of the study can be considered that collaborative working engages students to the course and that scaffolded meetings support working.

FIGURE 1. Framework of the study.



RESEARCH THEMES

- implementation of collaboration
- engagement to the course
- implementation of scaffolded meetings

The first and second research questions address students' experiences during collaborative learning. They are investigating which perceived elements of collaboration supported the learning process and which ones hindered it. The first question pertains to benefits. The question explores whether higher education students perceived collaborative learning to be beneficial from their perspective of course performance, meaning whether this teaching method had advantages for students in terms of their course outcomes. On the other hand, it aims to identify those individual factors and phenomena that helped students succeed in the course.

The second research question studies the challenges that higher education students faced while working collaboratively during the course. This question directly addresses the factors of challenges since working together often presents setbacks and difficulties. Secondly, through this question, the content and quality of scaffolded meetings can be developed for the future implementations.

The third question focuses on scaffolded meetings. It tries to construct understanding, how students felt about scaffolded meetings as a part of collaborative learning. The scaffolded meetings were constructed to answer the difficulties, which students felt in spring 2022 collaboration. Therefore, it is examined whether the challenges of spring were addressed or if a different approach to scaffolded meetings is needed. On the other hand, it is investigated whether students encountered new challenges.

1. What kind of advantages do university students experience from collaborative learning?
2. What kind of challenges do university students experience from collaborative learning?
3. How students experience remote scaffolded meetings as part of collaborative learning?

# 5 ANALYZING COLLABORATION DIMENSIONS WITH DATA-DRIVEN APPROACH

## 5.1 Programming course as research context

This study is a higher education research aimed at examining and developing programming courses from the perspective of students' engagement. The study aim is to research experiences of university students from a programming course in the form of scaffolded collaborative learning.

Programming courses face a nationally shared problem with a high drop-out rate. Hundreds of students enrol in programming studies, but on average, only 70% complete the course. At the University of Jyväskylä, pass rates have varied between 52% and 70,9% from year 2008 to 2021. Programming courses last for four months, are demanding, and assess students' perseverance. Reasons for the high dropout rates have been sought in course structures, study methods, learning environments, and motivation.

The research context is the programming courses at the University of Jyväskylä, namely Programming 1 and Programming 2, during the autumn of 2022. Teaching and activities during the courses were conducted in a hybrid format. Programming 1 was 6 ECTS credit course, focusing on basics of structured programming, the use and application of data structures. It introduced the students to algorithms and problem-solving. Programming 1 lasted 14 weeks and included 24 lectures, 11 demo exercises, a course project, and a final exam. Students had the opportunity to receive guidance for demo exercises from senior students, who had already completed the course. Guidance sessions were available every week, multiple times per week. Senior students also provided guidance and assessed the course project.

Programming 2 was an advanced level in programming. It was an 8 ECTS credit course, focusing on the Java programming language, principals of program design, object-oriented programming, program testing, and recursion. Programming 2 lasted 15 weeks, included 24 lectures, 12 demo exercises, a course

project and an intermediate exam. Guidance from senior students for demo exercise was also available several times a week, every week, in Programming 2. There was also guidance available for the course project, and assessment from senior students was a part of Programming 2.

Educational sciences have a long history of studying learning, participation, motivation, collaboration, guidance, and interaction. All these concepts are at the core of educational research. In this study, I constructed a six-step scaffolded remote meeting series designed to reinforce students' collaboration at the task and relational levels. The meaning of the meetings was to engage students in the course through collaborative learning and scaffolded interaction.

## 5.2 Participants

The participants were university students from different fields (N = 46). Hybrid teaching made it possible for both day students and working people to participate in the course. Participation in the study was voluntary and students could discontinue their participation at any point. Gender division mirrored well the dominant situation in programming field. Male students were 70% (N = 32) of all participants and female 30% (N = 14).

Participants were divided into small groups of 3 – 7 people, based on the on the times given by the students about possible working hours. Students had also possibility to request working face-to-face or remote. 9 groups were obtained from the participants. Seven groups from Programming 1 and two from Programming 2. Based on literature and previous interviews I estimated that groups size between three to seven would be reasonable: the groups would remain the same throughout the course, meaning that occasional non-attendance and possible drop-out during the course could be tolerated. Group size and number of groups could be managed by guiding resources. The groups were heterogeneous in term of discipline, gender, age and years of study.

After one week one group announced that they will work individually, and four members stopped collaboration from different groups. After two weeks

three members more had stopped collaboration from different groups. After three weeks groups and members stayed the same, leaving 8 groups to go with. After 10 weeks, one group announced that they will continue individually. 7 groups and 26 students finished collaboration after working 14 weeks together.

I as a researcher and as an instructor, was participating researcher and active participant. I instructed groups with six-steps scaffolded online meetings and participated in their conversation. I collected observations during the meetings and wrote observations in a diary, which I kept through our nine weeks interaction. I wrote down group members statements, feelings and roles during our meetings.

Every group had shared their email addresses with each other and had homepage in the course website platform where members could share important information, like phone numbers, meeting times, rules and diary turns. Scaffolded meetings included several tasks that were completed either as a group or individually. Self-reflection which was completed individually and was visible only to student and me. The group diary was visible to all members, and they had to take turns writing in it about what they had done during the group meetings.

For some of the participants in the study, courses were mandatory, while for others, they were an elective course. Every student who finished course with participating group working and scaffolded meetings, where giving one extra credit.

## 5.3 Data collection

The study used several data sources to perceive the multidimensionality of the student's experiences. Data collections temporal progression is depicted in FIGURE 2. Used data was collected from different sources in different times where the previous information was integrated to new implementation.

Study started in spring 2022, when the first groups started working in groups. Students from Programming 1 and Programming 2 were given opportunity to perform course in small self-organizing and self-directed groups in spring 2022. Voluntary had marked their willingness to be interviewed in feedback form after the course and I approached them with e-mail. Those voluntary from the groups were interviewed in summer 2022 online or face-to-face. Interviews gave information, what was good in group work and which factors brought challenges. Interview as a method was used to capture student´s real experiences from the first implementation.


FIGURE 2. Research gave information to 2023 scaffolded meetings.

Based on interviews conducted in summer 2022, six-step scaffolded online meetings were constructed (FIGURE 3). The structure followed Tuckman´s model of group development. In scaffolded meetings, we also covered interactions skills, the team´s collective interaction skills, and what dividing teamwork into task and relationship levels entails. The purpose of the topics and the ensuing discussions was to make students aware of the various factors influencing teamwork.

In autumn 2022, groups based on voluntary, were formed and they started performing programming course with scaffolded collaborative learning. Groups were formed based on the on the times given by the students about possible working hours. I approached students through a common email and encouraged them to contact each other. After making contact, groups were required to schedule a separate time from my calendar to begin teamwork. Every group had their

own "homepage", where all the important information was collected, e.g. contact information, meetings, links, schedule, materials, and group diary.

I used observation as a data collection method during the six-step scaffolded remote meetings to answer research questions about collaboration advantages and challenges. I wrote down all the discourse about group and group work in every meeting. Discourse proceeded at fast pace, so I had to develop a system how to record data. I wrote down simplified expressions from the discourse. I used exact words from discourse to keep the meaning as same.

I had made a document for each group. I recorded all the observations from one group to one document. I used meetings as division system. I had one document for each group, which was divided in sections according to six scaffolded meetings.

I worked as a facilitator during the meetings and participated in their conversation with guiding questions. I was a participant observer. I wrote down group members statements and perceptions from the interaction, during the meetings. Observation gave multifaceted information about group dynamic, cohesion, and interaction. Observation gave possibility to get students voices heard. The voices abled to move beyond formal teaching and to understand how students really feel about collaborative learning.

Scaffolded meetings were implemented remotely, using online video-mediated communication channel. The course implementation made it possible to complete the course completely remotely. Scaffolded meetings needed to follow the course implementation, so that all students, regardless of location, can participate in the meetings. Remote meetings supported students' skills to work life, where meetings have shift from face-to-face to remote meetings. Working remotely supported the implementation of the course as well as students' preparation for working life. Additionally, it was excellent way to understand students' experiences about remote interaction and computer supported collaboration.

Six-step scaffolded meetings were constructed to increase the interaction between groups members and to develop collaborations (FIGURE 3.). Themes for ever meetings were designed to increase group members´ knowledge of factors

that affect collaboration. In FIGURE 3 is depicted what kind of themes were covered.

First meeting started with familiarization round to get everyone know each other's. Grouping is basis to collaborative learning. Everyone introduced themselves (name, major and how many years studied, three things about themselves, which are strengthen and burdens in studying). Then we looked over the course timetable and talked how meetings intergrade to the timetable. Then students made rules to their collaboration (when they work together, how they communicate, what needs to be done before mutual meeting and how to act if one can´t participate). Last we checked over the tasks, that student need to accomplish (self -reflection and group diary).

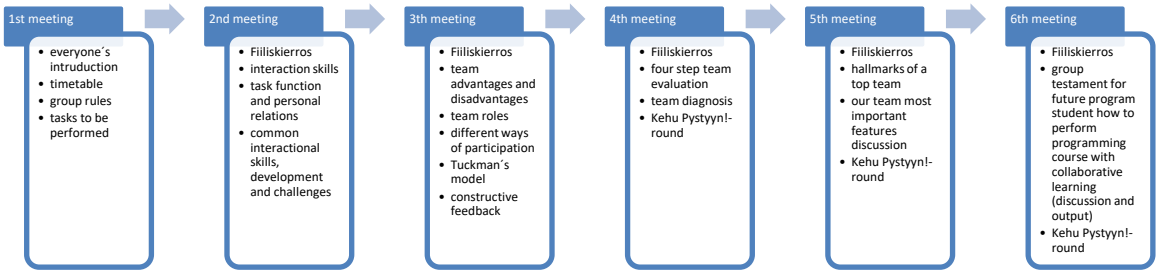



FIGURE 3. Construction of scaffolded meetings.

Second meeting started with Fiiliskierros, where everyone has opportunity to tell what the current feelings are, in what state programming demos are and how collaboration is going. Then we talked what is the different factors behind interactions skills and what they mean. After introducing students to collaboration´s task and relationship level and what kind interaction these levels contain, they discussed how these different levels emerge in their group and do we need to make changes. Last I talked about common interactional skills in group and how they can be developed and what challenges they have.

Third meeting started also with Fiiliskierros and same questions as last week. Second, research results about teamwork advantages and disadvantages were introduced. Based on results students discussed, how their collaboration is

working and is there any changes that could make their collaboration more effective and appropriate. Then students had to decide which team role from the given list would suit them best and why. Then different ways to participate was introduced and Tuckman´s stages of group development. Finally, constructive feedback factors were demonstrated.

Fourth meeting was about evaluation. It started with Fiiliskierros and moved to evaluate group through four steps. First is investigate (how things are), imagine (how they could be), innovate (which gaols do we set) and integrate (what are we going to do). After that they made group diagnoses from internet. My voice as an instructor and facilitator was minimum. Most of the time I was shut with my microphone and camera. Students' participation was brought up. And finally, we got familiarized with Kehu Pystyyn! -round, which is about positive feedback. Because this was first round, students only boosted the group.

Fifth meeting started with Fiiliskierros and moved to hallmarks of a top team. Then they had discussion about their team the most important features and wrote them down in their homepage. Some groups had their team diagnoses at this meeting, because time got up in the last meeting. And then we got the hole round of Kehu Pystyyn!. Idea is to praise first team, then yourself and last say some members name and to praise him or her. And the round goes on.

Last meeting was about finishing the collaboration. First was Fiiliskierros but then students made a testament to other programming students who will implement course with collaborative learning. They discussed about 30 minutes and wrote down all the challenges and benefits from their collaboration in programming course. After that they told what was best about their own group, what they have learned about working in group and what was their best moment as a member of their group. Then we had Kehu Pystyyn! -round and said goodbye.

I had recorded expressions from every meeting. Overall, 48 meetings resulted 41,5 pages of expressions in font size 11 and line spacing 1,0. These 41,5 pages worked as the data for my research questions one and two, about collaboration advantages and challenges.

Data collections to research question about students' experiences on remote scaffolded meetings were gathered by survey. A survey as a data collection method is used when the goal is to find out what people think. Participants from programming 1 received surveys, in the middle and in the end of the course. Programming 2 had only one survey at the end of the course, which was the same survey as programming 1 had in the end of the course.

The survey in the middle about collaboration was part of bigger survey conducted by the course teacher. Everyone in the course had a link to answer the survey. I had three open-ended questions about collaboration experiences in the survey. Answers about collaboration came only from the students that had signed-up to group work.

The survey in the end was conducted to all participants who had signed for collaboration. Link to survey was send after the last scaffolded meeting. Questions were about collaboration. I collected my data from three open-ended questions, which answered to my research question about experiences to scaffolded meetings.

## 5.4 Data analysis

The data for this study was analysed using a method called data-driven analysis, which is a qualitive content analysis method. Data-driven analysis aims to produce generalizations from the data, moving from the specific to the general. This study examined students' experiences about collaborative learning in the context of programming.

Based on spring 2020 interviews, students needed help with collaborative learning, specially how to study and learn together and how to act as a part of the group. Interviews were not part of this study, but they provided insights into the support areas encountered by the groups. Six scaffolded meetings were constructed to support groups collaboration.

To answer to the research questions, I needed to hear how the students spoke about their experiences. I used the discussions during the six scaffolded meetings as a data to answer my research questions about collaboration advantages and challenges. FIGURE 4. reflects how the study was constructed. Six scaffolded meetings gave information about advantages and challenges that students faced. Survey gave information how the students experienced scaffolding.

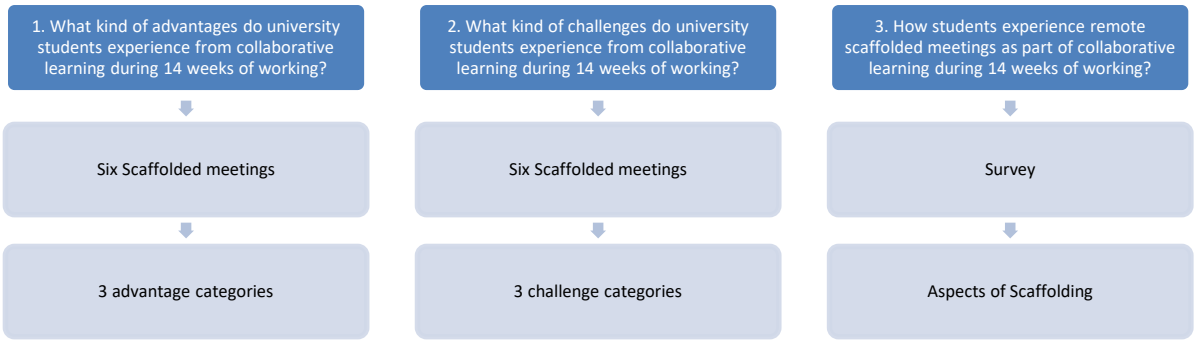



FIGURE 4. *Structure of the study.*

During the six scaffolded meetings in 14 weeks period, I focused myself to observe and wrote down expressions about group activity and collaboration. I used simplified expressions to maintain the true meaning of the experiences. Expressions like: "*The group members recognized that collaboration would provide peer support for completing the course*". After 14 weeks of collaboration and recording the data, I started my analysis.

In categorizing the data, several techniques were employed. Firstly, I colour-coded groups and their expressions with different colours. Colours reflect each group and their expressions. I had nine groups and nine different colours. I used colour-coding to organize data. Colour-coding clarifies the data, facilitates reproducibility, and reduces cognitive load.

Each meeting was divided by its own title during the data collection phase, 1. Meeting, 2. Meeting, 3. Meeting, 4. Meeting, 5. Meeting and 6. Meeting. Under

each colour-code, there were texts categorized into six sections according to the meeting´s. FIGURE 5. shows that the phasing of data collection for each group.

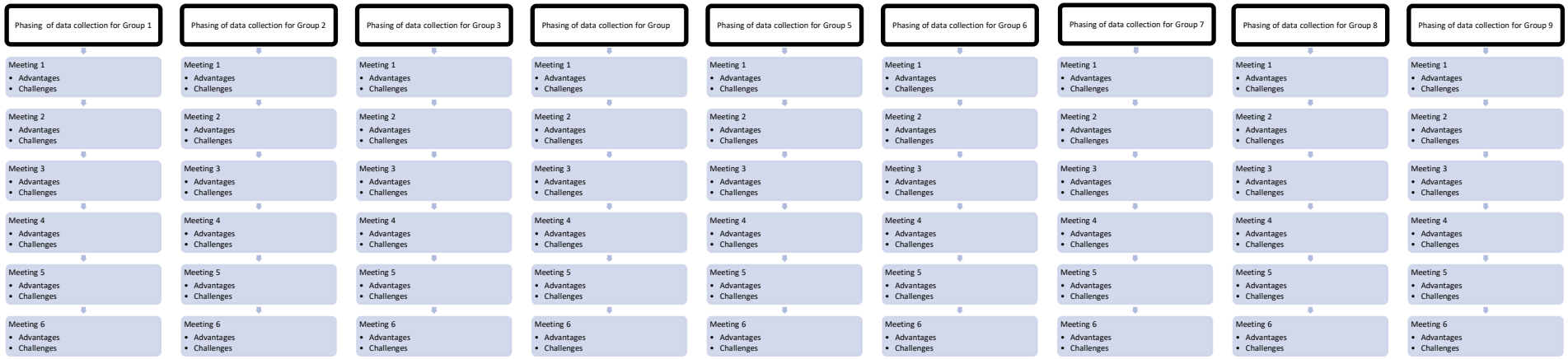



FIGURE 5. Data segmentation.

Once the data was colour-coded and segmented by meetings, I began to identify advantages and challenges. I needed separate documents for advantages and challenges. In the advantages -document, I gathered the advantages expressed by each colour-code group for each meeting. I used the meeting-based division as the basis. Beneath the first meeting, there were advantages expressed by all colour-coded groups from their first meetings. Beneath the second meeting, there were advantages by all colour-coded groups from their second meetings, etc.

Identifying the advantages and challenges from different meetings was done by reading and familiarizing myself with the data. Advantages in this study was defined as circumstance, condition, quality or characteristic that refers to favourable or beneficial and is positive factor that contributes to success or progress. When I identified an advantage from the data, I copied the section and added the colour-coded expression to the document where six meetings were categorized. The final document containing advantages included six meetings (1st meeting, 2nd meeting), with expressions of advantages listed under colour codes. Once the advantages were found under the meetings, I began to outline subcategories, of which there were 11. These formed three main categories of advantages of collaborative learning.

The challenges were categorized in the same way as the advantages. Beneath first meeting was all the expressions about challenges by all the colour-coded groups, etc. Challenge was defined as a difficulty, task, situation, or problem that requires skills, creativity, and effort to resolve it. Challenge is an obstacle between the student or group and the desired goal. I read through the data, and upon identifying an expression of a challenge, I copied the section and added the colour-coded expression to the document dealing with challenges according to the six meetings. The final document containing challenges thus included six subheadings, under which expressions of challenges from different meetings were listed with colour codes. From these lists of expressions, nine subcategories were formed, and from these, three main categories of challenges of collaborative learning.

To construct broad understanding of the phenomenon, I used phenomenological research strategy. Phenomenological research strategy is a qualitive research approach, that focuses on structures of experience, or consciousness (Smith, 2009). I was interested in how collaborative learning fits as a learning approach for programming courses. I wanted to hear students' description of perceptions and their interpretations.

I approach the data with data-driven content analysis to make the students experiences heard. As I mentioned before, I was interested of students' experiences, so I let the data speak for itself. In data-driven content analysis, researcher aims systematically and openly structure and understand the content of textual data. First, I gather my data about the students' expressions. According to Tuomi & Sarajärvi (2018), I shared analysis in three phases, reduction, grouping and creating theoretical concepts. In data-driven content analysis, analysis starts with familiarizing, coding and comparing codes, formulating and reassembling of subcategories and categories. Next, I open what these phases meant in my analysis.

Reductions is a phase where you look for expressions that will answer your research assignment and leave out the rest. I had partly done my reduction in data collection phase. As participating researcher, I didn´t have much time to write down the data, so I used simplified notations. In reduction I aimed to write notations, that preserved the essence and characteristics of the phenomenon.

I readied my data and gathered expressions of collaboration advantages in one document and collaboration challenges to another. From 41,5 pages of text, 75 expressions indicating the advantages of collaboration could be identified. Advantage expressions like "*Inner motivation helps with group working and group working motivates doing*" and "*Peer teaching and subsequent review reinforce learning*". These student expressions indicate how they had recognized groups impact to their studying activity and to learning itself, which are in the core of collaborative learning.

Collaboration included advantages but also challenges were identified. From 48 meetings, 79 expressions indicating collaboration challenges could be

identified. Students expressed challenges talking about participation, collaboration time, demo assignments, communication, attitude and courage to ask help. These challenges could be identified from expressions like "*Not all group members participate in the work*", "*Members go along with what others in the group say and don´t express own opinions or thoughts*" and "*Participation in the agreed meeting time is challenging even though the time was supposed to work for everyone*".

After reduction I moved on to construct subcategories from the reduced expressions. I constructed subcategories by collecting expressions that had the same meaning. Tuomi & Sarajärvi (2018) calls this phase grouping, where researcher tries to find similarities and differences from the data. TABLE 1 and TABLE 2 shows example how subcategories were constructed e.g. multi-perspective subcategory included all the reduced expression about how different viewpoints, opinions and interpretations advances collaboration.

Subcategories was constructed from the data. After this grouping phase, I combined the subcategories to categories which reflects them all. Tuomi & Sarajärvi (2018) calls phase after grouping as abstraction where the significant information is separated from the data and theoretical concept construction begins. I constructed three categories from advantages (TABLE 1) and three categories from challenges (TABLE 2). I also counted the number of expressions from all the groups during the meetings. I counted the expressions to reflect the which advantages and challenges emerge the most and in which point of the process.

Collaboration advantages were divided into three categories. The first category was clearly task-oriented, including multi-perspective, scheduling, and competence as a resource. The subcategory of multi-perspective encompassed all expressions focusing on the group members different approaches to completing demo tasks. How they approached tasks from different angles or reached desired solutions in various ways. Multi-perspective was seen as ability to look things from different perspective.

Multi-perspective refers to a mindset, whereas expertise as a resource is perceived here as concrete knowledge, skills, and attributes. Expertise as a resource

refers to the skills available to a group, which individuals or the entire group possess. This subcategory focuses on the actual doing.

Third task category's subcategory includes expressions about scheduling the actual doing. How the group helped to organise demos assignments during the week and perform them in time. This subcategory also included expressions where previous programming course experiences were compared to the advantages brought by the groups scheduling experience.

Second category focused on peer-level. How students as peers were at the same position, sharing similar experiences, knowledge, and skills. Peer-support was seen as the support and encouragement what group member offered to each other's, as facing the same experience. In the expressions, experiences or information were shared reciprocally for the benefit of others.

Whereas peer-support was seen as support and encouragement, peer-help was seen here as expressions to concrete help. Expressions like, "*Does someone need help*" or "*Do you want us together to look it through*". What these expressions had in common was the voluntary offering of assistance to a peer in need.

Last peer subcategory focused on the peer-teaching. This subcategory refers to an event, where students act as both teachers and learners. A student who had wider knowledge or skills on specific programming matter taught those who needed support or guidance.

The last category of advantages focused on the relationship level. It refers to quality and intensity of interaction between group members. Mainstay subcategory included various expressions from students about how the group acted as a mainstay throughout the course. How the interaction had become so intensive that students experienced that the groups collaboration carried through the course.

Motivation subcategory refers how groups interaction motivated students to act, continue the course, and will learn. In the subcategory, group interaction is seen to influence internal motivation and, consequently, students experience of how the group is perceived as meaningful.

Social support subcategory includes expressions of emotional support, concreate help and appreciation. It differs from peer-support based on the situation. In peer-support, students face the same situation, but in social support, students provide support to each other in different life situations and from differ backgrounds. Some groups met outside of class and offered support and assistance with matters outside of the course, such as work-related or car-related issues.

Group pressure was seen as a positive matter in collaboration. This subcategory included expressions of pressure related to group expectations, norms, and action. Students experienced groups pressure positively influenced behaviour, decision-making, and attitude.

The last subcategory of relationship level refers to students' experiences of how interaction increased the desire to be part of the group and complete the course as a member of the group. This subcategory includes expressions of a desire for social interaction with the group or to belong to the group.

TABLE 1. Formation of advantage category.

| Reduced expression | Subcategory | Category |
|---|---|---|
| *You can brainstorm ideas together*<br>*Going through tasks together and hearing how the other has solved the same task* | Multi-perspective | Task level |
| *The group keeps on schedule when it comes to demos* | Scheduling | |
| *Members diverse expertise as a resource for the group* | Competence as a resource | |
| *Experience that student is not the only one who does not understand* | Peer-support | Peer level |
| *Whatsapp, where concrete advice is shared, is actively used* | Peer-help | |
| *Peer teaching and the subsequent review reinforce learning* | Peer-teaching | |
| *Thought about quitting the course, but the group get going on Would not have made it without the group* | Mainstay | Relationship level |
| *A positive atmosphere within the group encourages participation and demo presentations* | Motivation | |
| *They take care of each other, ensuring everyone is involved and demos are submitted* | Social support | |
| *Group pressure compelled to watch lecture recordings* | Group pressure | |
| *It´s more enjoyable to work together than to toil alone* | Will to be group | |

Collaboration during the course included advantages as well as challenges. The challenges were divided into nine subcategories, forming three categories. The first category included task-related challenges. The first subcategory focused on finding collaboration time. Student found it very challenging to find common time or participate in meetings, even if a suitable time had been found.

The second task-related challenge addressed the course assignments, demos, and the course project, as well as their completion. In this subcategory, all expressions regarding the challenges related to the course assignments becoming more difficult as the course progressed, as well as challenges related to practical task completion and collaboration.

The second category focuses on collaboration interaction as a challenge. This was divided into four subcategories. The first subcategory included expressions referring to groups' communication. Communication refers to the transmission of information, thoughts, feelings, or ideas among a group. Communication belongs under the umbrella of interaction, but it does not necessarily imply interaction. Interaction refers to reciprocity and two-way communication, whereas communication can be either two-way or one-way. In this context, communication specifically refers to one-way communication as a challenge.

This subcategory includes reactions, or behaviours, to events and matters concerning the group and expressions about these reactions. Attitudes is specially seen as a challenge because it negatively affects the groups functioning. The attitude of induvial group members influences the attitude of the entire group.

Expressions of group member´s participation challenges fall into this subcategory. Participation as a challenge refers to passive or unequal involvement in the group´s activities and decision-making. Participation as a challenge manifested either in expressions from groups members or in the observed interaction during the scaffolded meetings.

The subcategory of courage to ask for help emerged as a challenge by affecting the group´s interaction. This included expressions of thoughts that asking for help disturbs others or fear that one´s own incompetence slows down the

progress of the group. Within this subcategory, elements of a safe atmosphere were touched upon, such as openness, trust, and a sense of acceptance.

The last category of challenges included a lack of shared acknowledge. The first subcategory included expressions of a lack of shared operational procedures. These operational procedures referred to collectively agreed-upon ways and methods to work together, such as working hours, communication protocols, or task allocation. This challenge manifested in instances where a lack of consensus negatively impacted the group´s functioning, efficiency, and productivity.

The subcategory of lack of understanding of the situation included expressions where it was discussed or became apparent that group members did not fully grasp the state of collaboration. The lack of understanding hindered the groups communication, actions, and decision-making. This also included expressions where the situation was understood, but there was a desire to deny reality. Denying refers to lack of understanding of the situation. If the group understands what is going on, they would have tried to fix it, because it would have been beneficial to them.

The last subcategory focuses on groupthink and the lack of awareness of it. Expressions of groupthink appeared in the speech or actions of group members. In these instances, group members thought or acted in a similar manner, adhering to the norms of the group. They did not express their own opinions but conformed to the majority´s actions or opinions. This subcategory emphasized a clear "us vs. others" mentality.

TABLE 2. Formation of challenge categories.

| Reduced expression | Subcategory | Category |
|---|---|---|
| *Hard to find time which is good to everyone*<br>*Members say they couldn´t come, even agreed time was good for everyone* | Collaboration time | Task |
| *Demos are getting harder and harder*<br>*The constructivist nature of the course* | Demo assignment | |
| *Nobody stars communication*<br>*Members don't answer to emails or text messages* | Communication | Interaction |
| *Forming group rules is unpleasant*<br>*Not taking things seriously* | Attitude | |
| *Some are present but they don´t share their own opinions*<br>*The irresponsibility of some burdens others* | Participation | |
| *Seeking help from outside*<br>*Fear of asking help* | Courage to ask for help | |
| *Different rhythm to progress*<br>*Working alone in the same room* | Lack of shared operational procedures | Lack of shared acknowledge |
| *It´s said that everything is fine, but experiences differ*<br>*Not facing reality, justifying why there hasn´t been collaboration* | Lack of understanding of the situation | |
| *One speaks, and the rest just nod along*<br>*Us vs. Others mentality* | Groupthink | |

All the categories represent dimensions of collaboration. Task level, peer level and relationship level constructed a combining category, collaboration advantages. Task, interaction and lack of shared acknowledge constructed a combining category, collaboration challenges. Combining categories, collaboration advantages and collaboration challenges represent the way of students experience scaffolded collaborative learning in the context of programming. Through content analysis, the most central themes and concepts of my research emerged which are presented in the Results -chapter.

I also answered research question three about students' experiences on remote scaffolded meetings by using content analysis. My data was collected by survey. First, I read all the data. I gathered all the answers regarding the collaboration from both surveys. The results of the survey conducted in the middle of the course were so few that it was not possible to form separate categories. In the results, I present minor answers in the form of quotations to construct an idea of the student's attitude towards guidance.

The survey in the end included six open-ended questions related to collaboration. I chose three questions from the survey, because the answers described students' thoughts about the functionality of the guidance. These three questions were:

- Would any change have improved your experience of teamwork?
- Share your ideas for developing the VAU activities of the future guidance.
- Chance that would have improved your experience?

All the answers were collected together. I read the answers and asked the data what the students wrote in here. In reduction phase I simplified the original answers but left the meaning. From these simplified answers I constructed subcategories to find answers that had the same meaning (TABLE 3). Subcategories were related to grouping, group forming, working and guidance content.

TABLE 3. Formation of scaffolded meeting dimensions.

| Original answer | Simplified answer | Subcategory | Category |
|---|---|---|---|
| *The beginning of group working was slow and tough for us (several weeks passed before the action got off to a good start) but on the other hand, I learned all kinds of things from the initial difficulties, so those did not in themselves make this teamwork experience worse.* | Grouping was hard and slow | grouping | Beginning |
| *The beginning was a bit rough and grouping and doing tasks was challenging to synchronize at first* | Hard to synchronize grouping and doing tasks | | |
| *When the groups have been divided, with a little more pressure the groups should be made to group up before the demos start. In this case, all group members would be better at the same starting level and the group members would like to get to know each other more* | Grouping before demos start | | |

In abstraction, three different categories were constructed. First category was about group forming and grouping. Second category was about implementation to group work. Last category deals with guidance implementation, as getting know each other, atmosphere and place. Categories are presented in more detail in the results section.

## 5.5 Ethical choices

All phases of the research have been carried out in accordance with good research practices and ethical principles. This chapter examines and evaluates the factors affecting the reliability of the research as well as ethical choices.

Participation in the study was completely voluntary and participants could stop participating at any point. The participants were able to read the announcements related to the study before and during the participation on the home page of the course they were studying. All participants gave written approval for their participation and data collection.

The participants were aware that information about them and their performance would be collected in a variety of ways during their participation. The research used material accumulated in the virtual learning environment of the course, such as assignment answers and survey answer, as well as observation during scaffolded meetings. The participants were informed in written about the pseudonymity, reliability and purpose of use before the decision to participate.

All material was collected respecting the pseudonymity of the participants. Individual identifying was omitted during the data collection phase, as it was not significant for the study. Group-specific data collection was reposted using a series of numbers that could not be linked to a group. The personal data used in the study was protected with a username and password and by utilizing the data protection of the servers of the University of Jyväskylä.

Data was stored on the university's protected U-drive with a username and password. All the material used for this study was destroyed after the thesis was completed. In the destruction of the material, I used overwriting and followed the principles of data secure destruction set by the university.

In the data collection situation, reliability could be weakened by the fast-paced observational discussion and related recording. I had to use simplified expressions to get everything written down. The scaffolded meetings were not recorded to keep the conversation as natural as possible. As result, I could not return to the situation later. On the other hand, the reliability of the research situation was improved by the fact that the observation was in synchronic with the real conversation, so the true nature of the conversation can be revealed in the result.

The student's personal attitude towards collaboration and scaffolded meetings may have also affected the reliability of the research results. Groups carried out collaboration in their own terms and they could participate in their working meetings when they wanted. Part of the working time in the working meetings and in the scaffolded meetings were spent discussing matters unrelated to the task. On the other hand, unrelated and informal discussions increase group cohesion. Student's personal attitudes towards scaffolded meetings may have affected the reliability in the form of short responses.

During the scaffolded meetings, I as a participant observer, got to know participants and that may have weakened the reliability of the study. I followed the researcher's objective attitude and kept the simplified expressions the same wording as the original expressions. Getting to know each other during the long collaboration could have also affected the participants answers in scaffolded meetings. Therefore, I chose to use data from the final survey to answer my research question about the experiences of scaffolded meetings. I wanted experiences of scaffolded meetings as truthful as possible. However, not all those who completed the scaffolded meetings answered the survey, so the data does not cover the experiences of all participants.

The results do not contain data from all six scaffolded meetings. The discussion tasks in the last scaffolded meeting directed the discussion to process advantages and challenges in collaboration. It would have been ethically wrong to use the number of expressions from the last scaffolded meeting in the results. Number of expressions are counted, but they are not included to the analysis.

# 6 RESULTS

This chapter describes the results from the content analysis. It will concentrate to answer to the three research questions. I will introduce the advantages that students experienced during the collaboration. Second section introduces the collaboration challenges that students experienced. In the last section, I go through the experiences of scaffolded meetings as a part of collaboration.

## 6.1 Advantages during 14 weeks of collaboration

First meeting was about getting to know each other and about planning of collaboration, like constructing rules. Meeting was formal and only few questions were asked. Students were more passive than active. However, one group had already been communicating via email and phone and they had already worked together before the first meeting and that showed in their communication. They felt that they are receiving peer-help and emotional peer-support from each other. This group was willing to meet several times during the week, and also in weekends.

Although most students did not know each other and the groups were not very active, we still manged to agree rules, set up a communication group on the phone and a regular working time for each group. Earlier mentioned group had met once before and that might had affected to their participation.

Four groups from nine expressed group work advantages or hopes for them already in the first meeting. Several students said that they had tried programming1 at least once before and acknowledge workload of the course.

> One member has tried programming 1 course three times and is aware that this course is even harder. Student hopes that group will help to schedule the working and the hole course. Student hopes that workload would not be so heavy, because all the work is not just over one person, and you would get help from the others.

This expression suggests that student is aware that course is hard, and that group could help to move forward. Strength of the collaboration has been identified in

relation to scheduling and sharing the cognitive load. This expression referred also to peer-help.

The second meeting was more relaxed. Most of the groups had already worked once and had idea how the working was going. There had been changes in few groups about the number of members and few group expressed advantages about that. One of the remotely working groups had shrunk from eight members to five. They felt that because the group was smaller, it was easier to make appointments.

> The remaining group members do not feel that the changes in group size would somehow negatively affect them. Maybe even the opposite. One student felt that making an appointment and working is easier now that there are fewer people.

Other groups also expressed advantages about group work and scheduling. They felt that is easier to keep up with weekly demo tasks because of the group schedule. Group schedule gives structure for the week and makes easier to keep up with course assignments. All the groups had listed in their rules, that lectures must be watched before coming to the meeting. This rule made collaboration easier because everyone had the same knowledge. One group also recognized that group members different competence worked as resource to the group.

Other expressions about group advantages were about peers and resources. Groups felt that they had received peer support and peer teaching from each other and that it helped. They recognised that it was beneficial to work as a group from the course performance perspective.

> The group feels that teamwork helps to motivate and schedule work. On the other hand, they feel that it is precisely the internal motivation of all of them that helps in teamwork. Motivation points in both directions.

Collaboration was expressed to members relationships. The observation note indicates that motivation is two-way. Collaboration is motivating group members and on the other hand, individual internal motivation is motivating group work. Seems that there is two-way motivation line between individuals and group. They felt that group is affecting their motivation (FIGURE 6). Internal motivation was driving them to work as a group and groups was motivating them to do demo assignments.


FIGURE 6. *Individual affect to the hole groups motivation and other way around*.

One surprising wish came from the students. One group felt that working in the same room with other students distracted their working. This was surprising because I did not see this coming. But after thinking it through, collaboration needs peaceful space. After the meeting I contacted the teacher responsible of the course and started looking for a separate working space for the group.

In the third meeting groups recognised similar advantages from group work that they had said in the previous meeting. They spoke about the help that they had received from each other and about peer support and peer teaching. One group had even felt the joy of succeeding. Groups also spoke about motivation. They were motivated to work as a group and towards tasks. They felt that group was connected to these motivation dimensions.

> Group members feel that they get peer support and learning from the group. They said that they experienced successes and the joy of learning. The group has fun together and they benefit from each other's different knowledge and personalities. The group discusses a lot of off-topic matters, and everyone feels that they know how to listen to each other. They have a lot of peer learning and teaching.

One new advantage was expressed. One group felt that their group works as a social safety net for them. This group was unusually quiet in this meeting.

However, they expressed several different expressions how group had supported and boosted each other to go on. This support and boosting worked to explain how they understood social safety net expression. Social safety net -expression did not appear within this group or in other groups ever again but other expression about social support was expressed later.

One another group expressed their willingness to have their own working space. I made reservations for them until the course ends. I offered this chance to other groups.

Fourth meeting included highest number of advantage expressions. Similar advantages were recognised like before, but they also found several new advantages. These new advantages focused more deeply on the meaning of the group. One group had suffered that they want to work together but work individually in their demo meetings. In the third meeting they had understood that the space where they worked was not suitable for group working, because there were present other people. I had booked a separate room for them to work and they found this separate room being helpful from the group work perspective. This group also expressed that they had started to feel them as a group.

Second new advantage was related to group force. Group was the mainstay to stay in the course. Few students would have quit the course without the group. Student felt that it was nice to work together and that got them going.

> They had been having fun together and had gotten the demos going well (even thought there were only four members present). They recognized that the tasks are getting harder and taking more time. You get help from the group and the group commits you to doing something. One had considered dropping out of the course but felt that the group was engaging and helpful. The group gives you different perspectives on demos.

Other advantages were also identified. Several groups experienced group being helpful. Three groups expressed commitment to in the group and one group suggested extra meeting to work with demos. Two groups had recognised, that group was the mainstay for the whole course. They experienced that the importance of collaboration increases week by week from the point of view of benefit.

Benefit was also found from task level and individual level. One group was feeling that working helps with problem solving, because members bring different solutions. Different solutions increase multi-perspective and riches thinking. One student felt that self-efficacy has increased, because of the group.

Long-lasting collaboration has made the students experience the joy of working together. In the fifth meeting students felt that spending time together has increased team spirit. One group said that it is fun working together. Other group, that had not started to work together, told that at the beginning they had thought that it would be nice to work as a group. They signed up for the group work, because they had feared that programming would be difficult, and group would help with that.

> The group is helpful, and they recognized it as supporting force. It is nice to work in a group. The discussion about the tasks is nice and the subsequent revision and peer teaching have strengthened the learning of the group members. The group has also found routines that work for their operations and with the help of routines the operation has become more efficient.

Students in one group felt that group have made them better in programming. Competence at group level have increased. They also felt that level differences have started to reach the same level.

Sixth meeting was closure to the collaboration. People were happy that only few tasks still had to be done. All the groups felt pleased about their collaboration. Atmosphere was nice and many smiles were expressed. All the subcategories, except peer-support, was expressed in the last meeting.

TABLE 4 shows all the advantages that groups felt in their collaboration process. One group had problems to experience advantages, because they did not start to work as a group in any point. But they could express hopes that they had at the beginning. Collaboration had taught new skills to few groups. Skills like how to work remote, study skills and how to speak out their thoughts.

TABLE 4. Collaboration advantages.

| | TASK LEVEL | | | | PEER LEVEL | | | | RELATIONSHIP LEVEL | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sche-duling | Multi-perspec-tive | Compe-tence/ re source | IN TO-TAL | Peer-help | Emotional peer-support | Peer-teaching | IN TO-TAL | Moti-vation | Social support | Group pres-sure | Main-stay | Nice to work | IN TO-TAL | IN TO-TAL |
| FIRST MEE-TING | + | +++ | | 4 | ++ | ++ | | 4 | + | | | | | 1 | 9 |
| SECOND MEE-TING | +++ | | + | 4 | +++ | +++ | + | 7 | + | | + | | | 2 | 13 |
| THIRD MEE-TING | | | | | +++ | +++ | + | 7 | + | + | | | | 2 | 9 |
| FOURTH MEE-TING | + | + | + | 3 | | +++ | + | 8 | +++ | ++ | ++ | +++ | + | 11 | 22 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | +++ + | | | | | | | | | | |
| FIFTH MEE- TING | ++ | +++ | + | 5 | +++ ++ | | +++ | 8 | ++ | ++ | + | ++ | ++ | 9 | 22 |
| IN TO- TAL | | | | 16 | | | | 35 | | | | | | 25 | |
| SIXTH MEE- TING | +++ + | ++++ | + | 8 | +++ | +++ | ++ | 12 | +++ | ++ | +++ | ++ | ++++ | 11 | 31 |
| IN TO- TAL | | | | 24 | | | | 47 | | | | | | 36 | 107 |

Students expressed collaboration advantages throughout the course. The number of advantages expressions increased towards the end. Students expressed advantages in the first meeting even they did not know each other. These expressions were related to the previous experiences of trying to pass the course or about rumours how hard the course is.

Third meeting was different from the others. In the third meeting, students did not speak as much as in the other meetings. The number of expressions about advantages were the same as in the first meeting. This could be related to Tuckman's model second phase, storming. Students have met and are not pleased with the working. Or they were tired, like they expressed in the meetings.

Advantages consisted of three categories: task level, peer level and relationship level. Categories adapt Tuckman's levels, but one extra category came from peer perspective. All the subcategories number of expressions increased during the six scaffolded meetings.

First category, task level, consisted of expressions related to scheduling, workload, multi-perspective and competence as resource. Task level was the least expressed advantage of the categories. Most advantageous student felt scheduling and multi-perspective. Students said that group was helping them to schedule the working during the week. Monday's demo assignment returns were easier to schedule with the help of the groups schedule. Rules played a significant role in scheduling. Group members multi-perspective to demo assignment helped with problem solving. One group talked about how the group members different competence worked as a resource to the group.

Second category was peer level. It was the most advantageous category. Almost half of the advantage expressions were about peer level. Students expressed growing number of advantages that group members as peer gave to each other. After working one time together, students expressed the advantage which collaboration was providing them. Peer level was consisted of three subcategories: peer-help, emotional peer-support and peer-teaching. Peer-teaching manifested in the as pointing out the fault in the code, telling how something is done or as Bandura has theorized by observing and modelling.

Most advantageous of these three subcategories was peer-help. This expression was used from the beginning to the end. Most expressions during the meetings were related to peer-help. It worked as a general expression about help and did not include clarifications.

Last category was related to group members relationships. It was the second advantageous category and consisted of over one third of the expressions made during the six meetings. Relationship level expressions grew little by little and was at the highest point in the middle and at the end of the course. Relationship level consisted of five subcategories.

Five relationship level subcategories were motivation, social support, group pressure, mainstay and nice to work. Most expressed was the motivation. Students expressed that group motivated them to work. Some students said that their motivation was lost but the group brought that back. It was a general expression and did not include clarifications.

Second advantageous subcategory was social support. It was expressed after one time of working together. Students said that they spent time together outside the course, like chatting about cars or having lunch together. Some students said that they do not know many students from university and group had come important social support for them. In one group one students said that working with the group felt like day off.

## 6.2 Experienced challenges during 14 weeks collaboration

Groups faced challenges before the concreate working had started. First instruction message encouraged the group members to contact each other and reserve a suitable time for everyone from instructors' calendar. Several groups had difficulties to get in touch with each other. Communication between the group members via email was difficult. Students did not answer to emails, or nobody started contacting. One student felt that instructor should handle the communication.

> "Student felt that instructor should had facilitated the group communication. Student expressed that instructor should contact all the members and agree on the first instruction time."

Observation note indicates that university students need help with contacting each other and with communication. They need someone who takes leading role and sends the first message to everyone. Arranging time also seems to be challenging for students who do not know each other.

Many challenges were expressed in the first meeting. The biggest challenges were related to communication, participation and attitude. Communication in the first meeting was difficult to few groups which was related to participation and attitude. Expressions related to participation appeared in the speech of a few groups. They did not want to fix regular time for their working. Attitude was expressed by laughing or shaking one's head when group was asked to form rules for group work.

> "Group did not want to agree on a fixed demo meeting time. Their close contact between group members and joint studies make it possible to agree on a weekly collaboration."

> "Their general atmosphere was distant, and nobody did not express willingness to do anything. The presentation was short, and the turn sharing was slow. It was not possible to find out from the group whether they had familiarized themselves with the home page or any page from the course at all. The division of responsibilities was difficult because no one wanted to take responsibility for anything or start doing anything at all."

In the second meeting challenges occurred. The most common challenge that groups faced was the lack of shared ways of working. The ambiguities concerned about common working time, how to work together and that they should work together. However, that all the groups had agreed regular working time, in some groups members experienced that they did not have regular time.

> "There were ambiguities in the groups schedule and in agreeing time. For some, it was unclear when and where to meet. Group agreed the same time as last week for demo working. The group jointly agreed that it will be recorded in the diary whether the group has additional working time or not."

Other big challenge was that in few groups, the members did not share the same understanding what was the groups situation like. Few expressed that everything was fine, and others said that teamwork is not working. Few told that they worked in the same room but individually.

> "Group members describe working differently. Three students say that everything is working perfectly. One student says that has not even started to do demo tasks. One says that they meet in the same room but work individually."

In the third meeting previous challenges were experienced, like participation working together and attitude. These two factors escalated to expressions of tension in one group. Few group members said that everything was fine, and one told that they have never met. Group did not have shared understanding of the situation. This group also expressed that they did not feel that they could ask help from each other.

> "Student expressed anger. Student felt angry because it was hard to understand that why they do not meet even they have agreed common working time. They have time and space reading in their home page, but members do not come to work together."

Few new challenges were expressed in this meeting. In few groups started to express group think. First group member said something, second said that agrees with the previous one. Third agreed and the round went on like this. This is called as group thinking in the analysis. Group thinking is a phenomenon where members conform to group thinking and do not think about a decision independently. Group members also giggled together but when there was time to participate in the shared discussion, they did not speak. One said something and last ones did not have anything to add.

> "The first one answers the question about the group´s task and relationship level participation. Group works effectively and they help each other. Next one says that this is how it is, and there is nothing to add. Next one repeats and says that nothing to add."

Second new challenge was about asking help. In the previous meetings most of the groups expressed that received help was one of the best things about the group, however now the situation was different in two groups. One student told that his not asking for help even though would have needed it. Student had different working pace and did not want to trouble others. Student had asked help from a person outside university.

In the fourth meeting students expressed the most challenges related to course assignments. They had problems with sharing the code in remote working. When you copied the code and pasted it to another online environment, it

changed. Groups also felt that demos are getting more difficult and there was not enough time for group work and for individual work.

Few groups also expressed challenges related to attitude and shared understanding about groups situation. Expressions of attitude were related to group work or working in scaffolded meeting. Some students told that working as a group was burdensome. They could not explain why they could not get the group together, even that they had agreed time for that.

> "Group was not concerned that they had not met. Thy felt that synchronized working was difficult to schedule, and it was laborious. They discussed that everyone is doing well at the time, and everyone manage to do demo tasks. One student said that we could have more collaboration and maybe we will have in the future."

Lack of shared understanding was expressed in the way how students talked about their working. Some members said that everything was fine. Others said that they are disappointed that they do not work together. They are not getting any help from the group. This indicates that the task problems are not so difficult for the members. They do not recognize the need for a group or the help that group would provide. Group members must need each other´s help so that the group becomes meaningful, and collaboration is necessary.

One group expressed that their individual goals are so different. Different goals are the reason for not to meet. And that they do not have shared understanding how to perform as a group. They would have needed instructions how to do demo tasks together.

Three groups had problems with scheduling. They were concerned that they are not doing this as a group because all the members are not in every meeting. One group was afraid that they separate from each other. This discourse was expressed together with the discourse about participation.

Challenges in the fifth meeting were diverse. Groups had different challenges. However, one challenge that was common to three groups was about attitude. Attitude was expressed by saying that problem solving was burdensome. One student said that he had thought to drop out the course, but the group kept going. This discourse took place together with discourse about course related challenges. At this point students had been in the course for eight weeks and

performed seven demo assignments. Many students expressed, how they were tired about the demo assignments and how demo assignments came into their dreams.

One student was expressing negative attitude, because their group was not working together. They had still obscurity about joint working time and what was the idea of this collaborative working. After this meeting group decided to stop being a group. They decided to work individually to the end of the course, like they had worked so far.

> "Discussion about collaboration transferred to messages via telephone. Two members said that this works well for us. I asked students, that has the individual working affected their performance in the course. Only one student answered. Student told that engagement to studying and to demo tasks have suffered because they do not have committing meetings."

Two groups had problems with communication and commitment. One group said that their demo-meetings had transferred from joint meetings to messages via telephone. They justified this by different schedules, competence, and general management of the course. Other group was challenged by the lack of discussion among group. They did not try to solve the problems together. They worked individually but said that everything is fine. Few members had finished that week's demos and some demos were in progress.

Challenges and advantages were in the centre of the final meeting. Groups discussed and listed challenges that they felt complicated their collaboration (TABLE 2). Six groups from seven said that lack of shared understanding how to work was the biggest challenge. Many groups recommended to discuss shared rules for the collaboration.

Second major challenge was commitment to collaboration. Groups said that all the members should be active in the collaboration. One group said that the beginning is the part, where members should be most active. Students discussed how common communication channel was absolute in collaboration. All the groups had common telephone-based channel to fasten communication.

Compared to advantages, many challenges were expressed in the first meeting. Challenges increased during the first three weeks of the course. After the

third meeting, challenges decreased. But still in the fifth meeting, quit many challenges were expressed.

TABLE 6. Collaboration challenges.

| | TASK RELEATED | | | INTERACTION | | | | | LACK OF SHARED ACKNOWLEDGE | | | | IN TO-TAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | collabora-tion time | demo as-signment | TO-TAL | communica-tion | atti-tude | participa-tion | courage to ask help | TO-TAL | lack of shared ways of working | lack of under-standing of the situation | group thing-king | TO-TAL | |
| 1. mee-ting | + | | 1 | +++ | ++++ | ++++++ | | 13 | ++ | | | 2 | 16 |
| 2. mee-ting | ++ | + | 3 | + | + | ++ | + | 5 | ++++ | ++ | + | 7 | 15 |
| 3. mee-ting | | ++ | 2 | ++ | ++ | ++ | + | 7 | ++++++ | ++ | ++ | 10 | 19 |
| 4. mee-ting | +++ | +++ | 6 | + | ++ | + | + | 5 | +++ | + | + | 5 | 16 |
| 5. mee-ting | | +++ | 3 | ++ | ++ | ++ | | 6 | ++ | + | + | 4 | 13 |
| IN TO-TAL | | | 15 | IN TOTAL | | | | 36 | IN TOTAL | | | 28 | |
| 6. mee-ting | +++ | +++ | 6 | ++ | + | ++++++ | | 9 | ++++++ | + | + | 8 | 23 |
| IN TO-TAL | | | 21 | | | | | 45 | | | | 36 | 102 |

Challenges consisted of four main categories: interaction, shared acknowledge and task related. Interaction induced most challenging to the groups, specially at the beginning. Eight groups from nine expressed challenge about interaction. Group that did not express interaction as a challenge was a group that had started their communication before first meeting. They had organized a common communication channel and worked together before the first meeting. This result indicates the importance of quick communication channel. After the first meeting, expressions about interaction, where expressed less and more steadily. Interaction as a challenge was expressed through the course.

The interaction category consisted of four subcategories: communication, attitude, participation, and courage to ask help. Expressions about communication, attitude and specially participation occurred regularly. These three subcategories did not leave out from the discourse at any point.

However, fourth subcategory, "courage to ask help", was expressed in three meetings. At the first meeting groups had not worked together, expect the one mentioned group. Challenges about asking help was not expressed after middle of the course. None of the groups did not mention "courage to ask help" as a challenge in the last meeting.

Interaction category indicates the importance of feeling that "we are a group". Group needs to feel that they are a group and they have shared goal which is achieved through synchronized collaboration. Everyone needs to take responsible from individual and group achievements.

Lack of shared acknowledge was the second challenging category. Lack of shared acknowledge consisted of three subcategories: lack of shared ways of working, lack of understanding of the situation and group thinking. Lack of shared acknowledge was expressed in few groups at the first meeting. It increased first three weeks and then decreased towards the end of the course. The most shared acknowledgement was lacking at the third meeting. Groups had worked together two weeks.

Lack of shared ways of working category was expressed in every meeting, and it manifested the most. Students did not share mutual understanding how they collaborate. Lack of shared ways of working was the second highest individual challenge in the collaboration. It was expressed in every meeting. Challenge increased first three weeks and then decreased.

Second subcategory was lack of understanding of the situation. Groups did not have this challenge at the beginning but after first week working together, expression were made. Two groups did not understand how things where. Some members spoke one thing and others something else. Challenge was expressed from second meeting, until the end. This indicates the importance of beginning and interaction order and sequence conveying performance.

Third lack of acknowledge -subcategory was group thinking. Group thinking was not expressed in many groups, and it did not manifest in the first meeting. But after one week of working together, it was expressed and manifested until the end.

Category lack of acknowledge indicates the importance of group reflection and feedback. Scaffolded meetings were constructed to facilitate group reflection, shared understanding, and feedback. Groups that did not practice group reflection and shared understanding did not evolve in their group working in the scaffolded meetings. Feedback during the scaffolded meetings helped groups to construct the understanding where they are in their collaborations and what should they develop.

Last challenge category was task related challenges. It consisted of two subcategories: collaboration time and demo assignments. This category was the only one, where expressions increased towards the end. This increasement is natural considering the constructive nature of education. However, the expressions were increasing towards the end, this was the smallest category of challenges.

First task related subcategory was collaboration time. Finding a common working time or working together at the same time were expressed until the middle of the course. Few groups did not find common working time even regular time was agreed.

Expression of demo assignments related challenges was not one in the first meeting. Steadily demo challenges started to increase towards the end of the course. Students said that demo assignments are getting more difficult and difficult week after week.

## 6.3 Meaning of the scaffolded meetings

Collaboration guidance was part of the collaboration. Based on the spring 2022 group working interviews, the groups would have needed support for working. They would have needed someone to get the group together, help them get to know each other, tell them how to work together and support them during the course. These challenges worked as guidelines for the new implementation.

New implementation was constructed to support collaboration throughout the course. Therefore, guidance included six meetings. Three meetings were held in three consecutive weeks to help grouping the members and the collaboration going forward. The latter three meetings were placed at regular intervals until the end of the course, as presented in the Methods -chapter.

New implementation gave promising results. All students enrolled in group work, passed the course. This includes members and groups that had finished their working during the course. Of the nine established groups, seven groups continued collaboration until the end.

Pass percentage increased in programming 1. In the fall 2022, programming 1 had the highest pass percentage between the years 2008-2022. Course pass percentage in fall 2022 was 80 % (FIGURE 7), which meant 200 students. Pass percentage increased 9,1 % from previous year. Worst pass percentage was in year 2008. Then only 53% from course students passed programming 1.

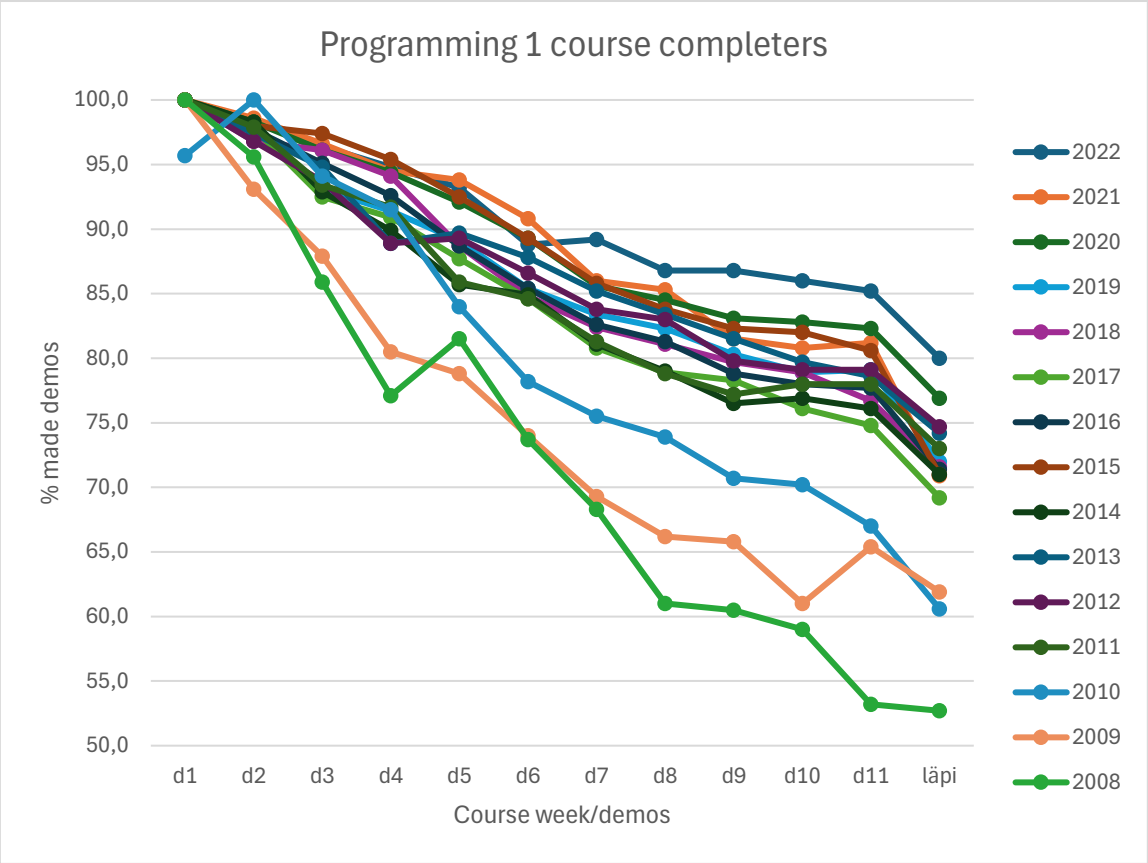



FIGURE 7. Course completers on programming 1 course in the fall of 2022.

Collaboration suggests to better pass percentages. 43 students signed up to collaboration at the beginning of the course. All the 43 students passed the course, and 26 of them passed the course in collaboration. 26 students were 10,4% from all the students signed to programming 1. Results indicate to the 9,1 % increasement from previous years.

Programming 2 on the other hand had the worst pass percentage ever. In fall 2022, only 51% from all the signed-up students pass the course. In programming 2, the best pass percentage was in year 2006, when 86,7 % of signed-up students passed the course (FIGURE 8.). Compared to the previous years pass percentage, fall 2022 pass percentage decreased 14% from year 2021 and 19,8% from year 2020.

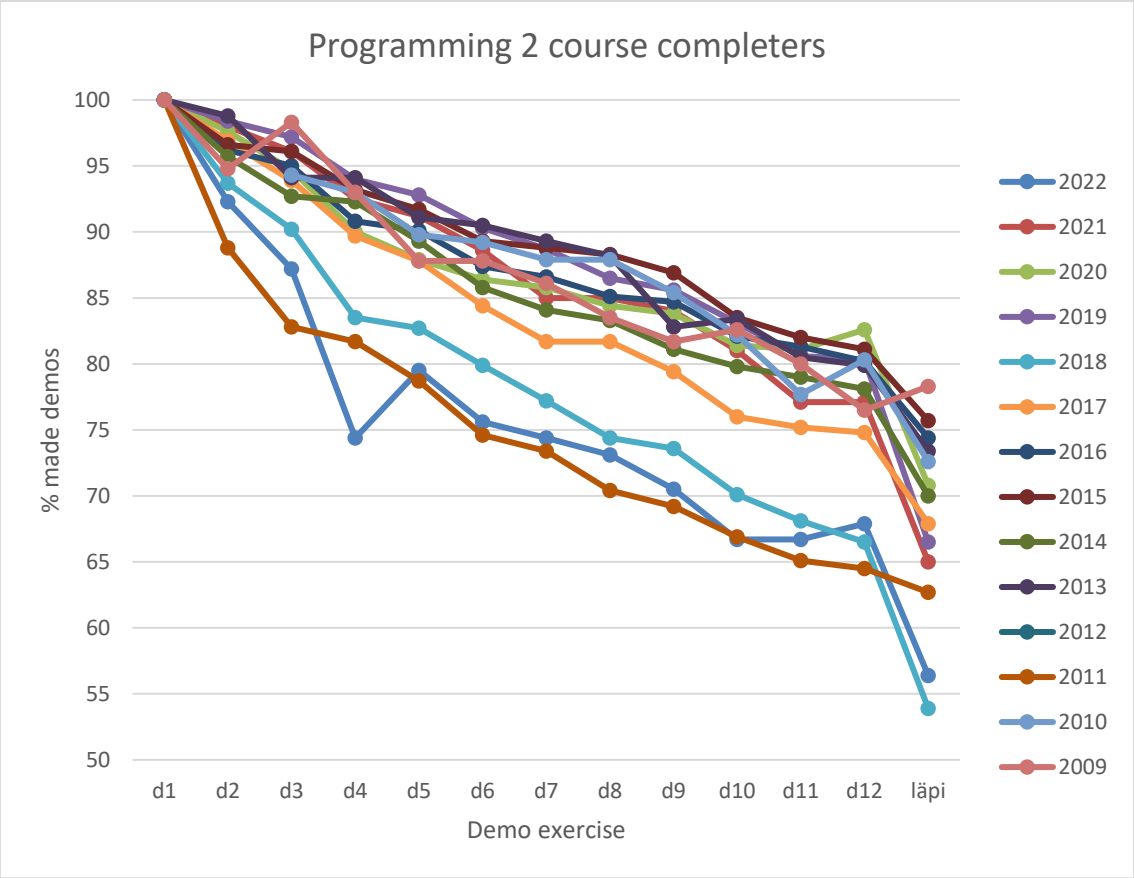



FIGURE 8. Course completers on programming 2 course in the fall of 2022.

Only two groups were formed from programming 2. 11 students signed-up to collaboration but only six students finished course in collaboration. However, the group sizes were small, and collaboration did not affect positively pass percentages, these two groups indicated effective collaboration. Both groups worked several times during the week and communicated frequently. Both groups expressed a wish to share experiences between both groups. Extra, voluntary meeting was arranged, where all the six participants attended. They were interested to hear, how the other group had worked, how many times a week they had worked together and how they solved the problems.

The student's experiences of guidance were asked. In the middle and in the end of the course students received a survey where they could give open answers to the questions. The purpose of the questions was to understand the student's

genuine experiences. I wanted to give the students opportunity to give feedback without my presence.

In the middle course survey, they could give suggestions for improvement and "twigs and roses" for the guidance. Middle survey was only for programming 1 students. 23 group members from 26 answered the survey. However, the response rate was 88 %, only few answers were given.

Suggestions for improvement were mostly opinionated. Few wrote that guidance was ok, useful, and very good addition. One wrote that "*The group VAU guidance has been functional and certainly helped the group work forward*". These refer that guidance has helped. On the other hand, one student wrote that "*group guidance quite pointless*". This quote indicates that guidance did not give them the help they might had needed.

Twigs and roses were mostly positive. Few students wrote that group work was the best thing in the course and thanked for that, like "*I especially like VAU-group*" and "*Thank you for the opportunity to VAU -group working*". One feedback was about student own group. Student was unhappy about their group situation and did not feel group being helpful.

> " Unfortunately, our VAU-group has not caught wind and I have not found it as useful as I had hoped. We spoke in the guidance of the VAU group and tried to fix e.g. more time together with the group, which has improved working together a little. However, I have benefited more reflecting things with PÄÄTEOHJAAJAT or with a friend who has been at the same time in PÄÄTTEOHJAUS, than in VAU group."

At the end of the guidance, students were asked to answer to final survey. Three questions in the survey gave answers about scaffolded meetings. Students felt scaffolded meetings positively but had also suggestions to develop it (TABLE 7).

TABLE 7. Formation of scaffolding aspects.

| **Simplified answers** | **Subcategory** | **Category** | |
|---|---|---|---|
| Hard to synchronize grouping and doing tasks | Grouping | Beginning | Aspects of scaffolding |
| Grouping was hard and slow | | | |
| Grouping before demos start | | | |
| The same fields in the same group | Group forming | | |
| At least ten members in one group | | | |
| Own space for group work | Working space and group documents | Instructions for collaboration | |
| Document to share codes | | | |
| Faster response of staff to ambiguities | Instructions | | |
| Plan and instructions how to do demos in collaboration | | | |
| Setting goals and rules | | | |
| Instructions to support group work | | | |
| Name game in the first meeting | Getting know each other | Guidance implementation | |
| Getting to know each other | | | |
| Bragging was good | Atmosphere | | |
| More informal meetings | | | |
| Amount and depth of discussions | Too much depth in discussions | | |
| Face to face guidance | Place | | |

First category from the survey was related to at the beginning of the group work. One student felt that group size should be ten. Other student felt that all the members should be from the same field, to easier the scheduling. Students also felt that grouping was hard at the beginning and should be started earlier.

> "When the groups have been divided, with a little more pressure the groups should be made to group up before the demos start. In this case, all group members would be better at the same starting level and the group members would like to get to know each other more".

Second category was related to group work implementation. Student felt that they would have needed more support and guidance for the working. Groups working face to face would have needed working space strait from the beginning to get working going. Code sharing turned out be difficult and they needed help to arrange document for sharing the code.

Instructions for working was also needed. In first meeting rules for working were created. Few students felt that setting goals and creating rules helped their working. Setting common goals helps group members to direct doing in the same direction. Everyone knows what to be done and look for different solutions to achieve the goal. Rules brought structure to working and helped to start.

> "Getting started was the hardest of all. It would be good to offer to a group the possibility of booking your own space and encourage to do a clear schedule for meetings, because everyone is a bit lost at first and especially with strangers, meetings can be awkward at first. When you have a clear plan, you do not need to think at the beginning, what now. Perhaps the most important part of this planning, in my opinion, is to decide whether the tasks are done together, progressing with the strength of the whole group or with another way."

As this student wrote, although the rules were made at the first meeting, they would have needed more specific plan for the working. This was very interesting result, because most students expressed frustration when the rules were made. Few students even said that we do not need rules. But still, more specific instructions were needed.

Third category was about guidance implementation. Guidance helped group members to get know each other better. One student suggested a name game with programming languages to start introducing.

> "I think, group work was supported by guidance sessions where you could get to know each other better and to think about working in a group. In a group there was a good and open atmosphere, which facilitated and encouraged studying."

One student wrote that "Kehu Pystyyn! -round in the end of last three meetings was a nice activity. Another student suggested informal meetings to help with group spirit. Even more meeting was suggested, one felt that amount and depth of discussion was sometimes too much. "*I do not think it was always necessary to think about the group activity so deeply, because everyone knew basic teamwork very well*". This brings up the individual aspect and needs, which everyone has in the group.

One student wrote also about guidance arrangements. Guidance was implemented as remote guidance to ensure everyone's possibility to participate. One student felt remote guidance did not give possibility to express facial expressions and gestures. "*Proximity guidance? Face to face expressions and gestures would be more natural*". This might be consequence from Covid-pandemic, when all the teaching and guiding was transferred to remote. On the other hand, practicing remote working and interaction provides good preparation for working life.

# 7 DISCUSSION

The aim of the study was to find out could collaborative learning support university students in completing programming courses. Research questions about collaboration advantages and challenges tried to find out how students experienced collaboration in programming courses. Students' experiences about collaboration were diverse. They experienced that specially peer and relationship level advantages helped them through the course. A long-term and problem-solving oriented course with difficult tasks strengthened the group´s cohesion and peer support increased towards the end.

The students also faced challenges while working. The biggest challenge turned out to be interaction. Even though the students received external support for their collaboration, they experienced that communication, attitude and participation were affecting the most negatively to their collaboration.

Based on previous, uninstructed, collaboration, the students needed aid for their working. Six scaffolded meetings were constructed to support students' collaboration. The aim of the scaffolded meetings was to improve group cohesion and construct mutual acknowledge. Students found scaffolded meetings helpful but would have needed more instructions and help for the beginning and for the actual collaboration and problem-solving.

## 7.1 Review of results and conclusions

This study revealed several interesting things about the collaboration of university students in the context of programming. Even though the challenges were tried to be resolved through scaffolded meetings, there were still previously identified challenges and new ones emerged. However, the experiment was not wasted, even though there were challenges, but the collaboration was also beneficial.

Students had big hopes for the collaboration at the beginning of the course. Students wanted to perform course in interaction with other students. During and at the end of the course peer level and relationship level advantages were the most expressed, which refer to the importance of interaction in collaboration. Interaction which included reciprocal communication, engagement, and exchange of information. This result is in line with Vygotsky´s (1978) view, human is based on interaction and full cognitive development demands for social interaction. Students received social support, help and peer-teaching from each other which was experienced as an advantage which could not be achieved studying alone.

Collaborative learning can be effective learning approach, but it requires active participation. Larochelle & Bednarz (2010) sees that learning is an active process, which demand participation. Students experienced that the scheduling required by the collaboration increased activity in the group, studying, learning and course-related performances. Activity increased motivation. The more groups met, the better the collaboration went, and students experienced the better the results were. The result supports Qureshi et al. (2021) findings that active collaborative learning and participation is connected to learning performance. Their study of university students indicated that active collaborative learning positively and significantly relates to student engagement.

Students experienced that collaboration helped them with task related things. Scheduling the working in accordance with the group´s work helped to keep up with the course schedule. Group pressure in a positive way forced to look through lectures and do the demos, so that collaboration does not suffer.

One of the surprising results of the study was related to the importance of creating rules in collaboration. Previous, unsupported group work in spring 2022 without scaffolded meetings, demonstrated that if the working does not have agreed ways of working, cooperation is very challenging and unpleasant. Groups constructed mutual rules for collaboration in the first scaffolded meeting and wrote the done in their homepage. Most groups operated according to the rules, drew up new rules independently as the course progressed, and were satisfied

with the jointly agreed methods of operation. This finding is consistent with previous studies. Effective and appropriate working needs shared rules to guide mutual functions and interaction situations (Salminen, 2017) and that having group rules is connected to teamwork satisfaction (Scott-Ladd & Chan, 2008). However, rules were constructed in every group, some students did not experience they have rules or that they should follow the rules. Some students said that their group does not have a fixed meeting day and time. This was interesting result, because meeting time read in their home page and some students still experienced, that they have not fixed meeting time.

Groups experienced several challenges during their 14 weeks collaboration. Interaction proved to be the most challenging dimension for the groups. Agreeing general things, such as meeting, keeping touch and engaging to collaboration proved to be difficult. Such challenges signal that university students lack collaboration skills. This result follows Le et al. (2018) research, where higher education students one challenge in collaboration was lack of collaboration skills. These results indicate that university students need teaching about collaboration.

Another big challenge was related to lack of shared acknowledge. Students did not have shared understanding of working and lack of understanding what the group situation was. However, scaffolded meeting's main purpose was to help groups with shared acknowledge by group reflection and feedback, groups had difficulties with it. Commitment to the group and absences can be related to the lack of shared acknowledge. Zheng et al. (2023) found while studying college students that learning engagement, group performance, collaborative knowledge building and socially shared regulation significantly improved when groups received external help with group engagement. Scaffolded meetings were offered to all groups. Results were contradictory. Some groups performed well, and some had challenges.

Results about challenges connected to the survey about the scaffolded meetings refers that the beginning is the most crucial part of the collaboration. Students needed help with communication, scheduling and making of rules. Students also felt that they would have needed more help with actual collaboration

and how do the course assignments collaboratively. Students in university are grownups and they should be taught according to the principals of andragogy. Andragogy emphasizes adults own will, motivation and autonomy. Participation to collaborative learning was voluntary which can be interpreted as a motivation to teamwork. However, some students felt that everyone is not being serious about collaboration. Some did not participate in the agreed meetings or to collaborative reflection. Participation would have been important for the groups to get familiarized and to build trust (Pöysä-Tarhonen & Tarhonen, 2016; Thompson, 2009). Groups did understand why they should meet more than once a week but could not start work according to that. Two groups from programming2 experienced the collaboration fruitful and were interested in hearing from each other collaboration methods. I arranged an extra meeting for them to have informal conversation about the course.

Problem and problem solving in one of the core elements in collaborative learning. During the research two groups stopped their collaboration. Groups named that scheduling was the biggest problem in the group and that they could manage by themselves. Managing by themselves indicates that they do not see the group helping them or that the group is relevant from the perspective of their course performance. Students need to experience that they need the group and that they receive help from it. This also goes hand in hand with andragogy´s power with-principle. Students need to feel that they are more powerful together and that they can receive peer-support and peer-help from each other. This sets requirements regarding course assignments and group formation. Assignments needs to be enough challenging to motivate students to collaboration. In the future, it is appropriate to consider whether the level of the group members should be maintained. On the other hand, motivated and committed group members actively participate in work regardless of level differences. Previous studies agree that nature of the problem should motivate group members to cognitive responsibility (Palincsar & Herrenkohl, 2002; Cockrell et al., 2009).

From the group perspective, study gave interesting information about group performance. First, every group is different. Some like to work face-to-face

and some remotely. One group meets once a week, another three times a week and communicate via telephone several times a week. Universal instructor that fit to all groups cannot be made. Every group needs to construct their own rules and ways of work. Second, the beginning does not reflect how the group will perform in the end. Many groups had difficulties still after halfway but managed to get the group work effectively in the end. Comparing to the Tuckman´s team development stages all the groups did not went through all the stages. One group did not progress from the storming phase because they did not face and admit the true situation of the group. Every group went through their own path and progressed at their own pace at different levels.

In my study Tuckman & Jensen (1977) forming stage included introduction, rule construction, scheduling and division of responsibilities. Storming was lack of participation, denying the group situation, agreeing on schedules and communication problems. Norming showed as permanent working, effective working methods and active communication. Performing appeared in half of the groups as high motivation and trust, active communication, joint problem solving and reflection and as a shared experience of success. Last phase, adjourning, did manifest in almost all groups. Adjourning seemed as satisfaction and happiness to collaboration, recognition of collaboration advantages and as sadness about finishing the collaboration.

One of the main purposes of the research was to study if collaboration could help tackle the high drop-out rates in programming. Results were promising with the scaffolded meetings. All the students participating in the study passed the course. This result should be critically considered. Result may reflect only specific situation and cannot be generalized to describe all the becoming collaboration in programming courses.

## 7.2 Research reliability and follow-up research

The study used qualitive methods, which was well suited to the study, as the aim was to focus on student's experiences of collaborative learning in programming courses. Scaffolded meetings were constructed to facilitate collaboration and to enable students to reflect together. The research provided answers to the set research questions. Conversation during the scaffolded meetings gave rich information about the groups and how students experienced the collaboration. The conversations were analysed accordance with data-driven content analysis, from which was formed categories to reflect different categories of collaboration advantages and challenges and experiences about scaffolded meetings.

The study also used quantitative methods to describe the connection of collaboration and scaffolded meetings to course performance. The use of quantitative methods is justified because numbers give support to the study results about students experiences. The generalizability of the results should be questioned. Results does not give general information how students experience collaboration or scaffolded meetings in each time the course is implemented. Students are individuals and every group is different in every environment. This study gives information about this specific phenomenon. Results can be reviewed as indicative information, which can be applied to future implementations.

As a participative researcher, I needed to keep open and objective to the expressions. Researcher should participate in data collection without any presuppositions and definitions (Patton, 2015) and be aware of the factors that might affect the formed perception of the phenomenon and critically examine them (Valli, 2018).

Data was collected during the conversations by the participating researcher. This should be critically considered. Gathering data during the conversation by writing reduces the reliability of the data. Some speeches may have been left unrecorded despite careful note method and it is not possible to return to the situation. On the other hand, genuine presence and participation from the researcher enables a safe atmosphere to share experiences.

Participation to the study was voluntary. Students were offered one credit if they worked with the group until the end, completed the given group-related tasks and participated in the scaffolded meetings. Credit might have affected to students' motivation to participate in the research and to collaboration.

In the future is should be considered whether university should incorporate more scaffolded collaboration for students. According to this study, university students need more guidance with collaboration. Collaboration skills are needed in university, social life and in the working life. Specified for programming courses, it is good to consider whether the students would benefit from the guidance provided by the course teachers. Course teachers could give more detailed information on how to solve tasks together.

Phenomena was so multi-dimensional that it gave further research topics. The students mentioned few times the ideal group size in their discussions. Opinions were diverse and could not be constructed as result. Forming groups according to level differences and studying them would give interesting information about collaboration.

Research provides information about human behaviour and based on that, the aim is to build a good education system. However, we cannot assume that everyone works and behaves the same way. This also applies to collaboration. The importance of collaboration will increase in the future. University prepares students for working life, in which case they should also provide research information on the prerequisites for successful collaboration.

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