Teacher education students' strategic activities in challenging collaborative learning situations

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Abstract

This study gives voice to individual students' reflective interpretations of the challenges that they face during collaborative learning. It show how students describe their strategic activities to overcome these challenges and illustrates how the described challenges are actualized in practice. Forty-three second-year teacher education students worked in small groups during a seven-week didactic math course. Individual students were interviewed after the course and asked about their interpretations of their collaboration in general, as well as their applied strategic activities during challenging collaborative learning situations. The data was complemented with two student groups' video recordings dealing with the group work in order to analyze how the students identified challenges during their collaboration and what types of strategic activities they used to solve these issues. The results showed how students' strategic activities varied among different challenging situations. The students were able to identify and solve the task-related learning challenges in particular. In contrast, motivational and emotional learning challenges were not recognized and solved that often. It is concluded that ignoring the challenges that students are experiencing can affect their collaboration in many ways such as creating a general work atmosphere, causing unequal participation or lower satisfaction with group learning.

Keywords: Collaborative learning, self-regulated learning, challenging learning situations, qualitative analysis

1. Introduction

Research on collaborative learning has been active over the past decades (O'Donnell & Hmelo-Silver, 2013), focusing on different conditions of collaborative learning (Mullins, Rummel, & Spada, 2011), various processes of (successful) collaborative learning (Miyake & Kirschner, 2014), and students' collaborative discourse and argumentation on their collaborative learning in

general (Damsa & Ludvigsen, 2016). These studies provide information about collaborative learning processes as such and their findings help designing effective collaborative learning models and scripts in general (Fischer et al., 2013; Kobbe et al., 2007). However, regardless of the increasing amount of research on collaboration and its contribution to learning, the field still lacks understanding of why and when groups engage in successful collaboration and why they sometimes fail (Barron, 2003; Miyake & Kirschner, 2014). Collaboration is not spontaneous and does not happen simply by putting students to work together. Collaboration is a situated process in which the learning context and individual students' personality, experience, prior knowledge and learning skills are interrelated (Miyake & Kirschner, 2014; Puntambekar, 2006). It is also a process in which individual students' interpretations about the learning situations are part of the shared meaning-making process contributing to the success of collaboration (Baker, 2015; Häkkinen, Järvelä, Mäkitalo-Siegl, Ahonen, Näykki, & Valtonen, 2017).

Recent research has indicated an emerging interest in students' self-, co-, and socially shared regulation in the collaborative learning context (Järvelä, Järvenoja, Malmberg, Isohätälä, & Sobocinski, 2016; Kempler Rogat & Linnenbrink-Garcia, 2011; Volet, Vauras, & Salonen, 2009). These studies have shown that different strategic activities are key elements for success in collaboration (Kempler Rogat & Linnenbrink-Garcia, 2011; Saab, 2012). For example, socially shared regulation can contribute to groups' learning achievements if activated at the right time and place (Järvelä, Malmberg, & Koivuniemi, 2016; Pintrich, 2000). Self-regulated learning (SRL) is also connected to higher-level engagement and persistence during time-consuming and challenging learning tasks (Boekaerts, 1996; Perry, VandeKamp, Mercer, & Nordby, 2002; Zimmerman, 2011). In these studies collaborative groups are especially understood as social systems that comprise multiple self-regulating individuals who simultaneously guide and support their own strategic activities and their groups' shared strategic activities (Hadwin, Järvelä, & Miller, 2011, 2017; Volet,

Vauras, et al. 2009) by intentionally negotiating task goals, monitoring progress, and adapting and persisting when facing challenging learning situations (Winne & Hadwin, 2008).

On the basis of the existing research, it seems that the role of individual students in a group is something that still needs more understanding. Earlier studies have considered individual students, for example, in interactive processes and argumentative behaviors between group members (Asterhan & Schwarz, 2009; Baker, 2009; Isohätälä, Näykki, Järvelä, & Baker, 2017), and how these processes are connected to the group's strategic activities (Kempler Rogat, & Linnenbrink-Garcia, 2011). In addition, the effectiveness of individual students' regulatory learning skills for a group's shared learning processes have been studied (Panadero, Kirschner, Järvelä, Malmberg, & Järvenoja, 2015), pointing out that individual students play a vital role in group learning. Less is known about the 'silent' information of collaboration, such as behaviors and thoughts that are not spoken aloud or expressed during students' interactions (Robinson, 2013). In all, the individual students' interpretations form the basis for their shared meaning-making process (Baker, 2015; Häkkinen et al., 2017), affecting the students' choices, motivations and emotions but also contributing to the success of the students' collaboration. Therefore, the current study combines individual- and group-level data to provide an understanding about the functioning of the groups' strategic activities in collaboration.

1.1. Collaborative learning: challenges and opportunities

High-level collaboration is not spontaneous but dependent on individual group members' capability to interact with one another (Barron, 2003; Miyake & Kirschner, 2014). The interactive nature of collaboration (Isohätälä, Näykki, Järvelä, & Baker, 2017) has all the potential to both support groups' learning success (Kirschner, Paas, Kirschner, & Janssen, 2011) and distract collaboration (Janssen et al., 2012) by causing new types of challenges for students' collaborative learning (Blumenfeld, Marx, Soloway, & Krajcik, 1996; Miyake & Kirschner, 2014). For example, the lack of a positive atmosphere and social support in the group, as well as difficulties in reducing

the individual members' anxiety, may follow social and psychological problems in group learning (Laal, 2012). A study also found how a lack of respect and not listening to others could have consequences for the overall quality of group functioning (Webb, Ing, Kersting, & Nemer, 2006).

It seems that challenges in students' collaboration are intertwined to other types of challenges. For example, Näykki, Järvelä, Kirschner, and Järvenoja (2014) studied the cognitive, motivational, and socio-emotional learning challenges of students in higher education and in a collaborative learning context by using video analysis and conducting video-stimulated recall interviews. They found that challenges in students collaborative work and communication led group members to avoid solving the socio-emotional learning challenges and affected their task engagement. Van de Bossche, Segers, and Kirschner (2006) noted similar findings in their study of when and how groups in a collaborative learning environment engaged in building and maintaining mutually shared cognition. They suggested that interdependence, task cohesion, psychological safety, and group potency would be crucial for students' engagement in collaborative learning tasks, which could give rise to mutually shared cognition, making it possible for them to achieve higher team effectiveness in collaboration.

Concerning collaborative learning in the teacher education context, Litmanen et al. (2012) studied teacher education students' contextual learning experiences in lecture-based and collaborative-learning contexts. They found out that challenging inquiry-learning tasks had a greater negative impact on teacher education students than did teacher-centred learning tasks. The authors suggested new learning designs, such as collaborative inquiries, that would create new learning challenges and require students to look for ways to cope with these learning situations. Other findings indicate that challenging learning tasks can also promote collaboration. Scager et al. (2016) studied higher education students' experiences of successful collaborative learning. In their study, students who worked in successful collaborative groups reported that especially challenging

learning tasks, in which they had the autonomy to make decisions by themselves, supported group engagement and the learning success.

Students' reactions and behavior when facing challenges while learning are connected to collaborative learning success. Barron (2003) studied elementary school students' collaborative learning and found that successful groups were not immune to challenges and problems in their learning. The difference in between successful and less successful groups was that the successful group students' strategic activities to cope with challenges evoked a joint focus of attention, which contributed to the shared understanding in collaboration.

1.2. Self-regulated learning in challenging collaborative learning situations

In collaborative learning, challenging learning situations and students' self-regulated learning are related. The need for regulation of learning and behavior emerges when students are facing challenges (Hadwin et al., 2011; Perry, 1998; Pintrich, 2000; Winne & Hadwin, 2008; Zimmerman, 2000). Furthermore, the encountered challenges can turn beneficial if the students manage to regulate their learning activities with relevant strategic activities (Linnenbrink-Garcia, Kempler Rogat, & Koskey, 2011; Malmberg, Järvelä, & Kirschner, 2014). These strategic activities can be cognitive, motivational, emotional or behavioural in nature. Cognitive strategic activities include helping students to understand and learn course material better (Pintrich, 2000). Different motivation regulation strategies can help students to raise their interest in the learning tasks by, for example, evoking extrinsic goals, promising extrinsic rewards or using positive self-talk (Boekaerts, 1996). With different emotion regulation strategies, students can modify their emotional states that are distracting them from their learning. Behavioural strategic activities help students to re-organise their learning by, for instance, making new plans, revising time schedules and so on (Pintrich, 2004).

It seems that individual students' own monitoring judgments form the basis for the strategic activities (McCardle & Hadwin, 2015). As research in self-regulated learning has shown, to

overcome the challenges they face, students have to first become aware of them and monitor their progress towards their learning goals (Pintrich, 2004). When this happens, students are able to make strategic changes in their learning in order to face those challenges, and this allows them to make adaptive changes in their learning (Hadwin et al., 2017). This is the case also in challenging collaborative learning situations where joint strategic activities can be start after individual group member/s have first individually become aware of the situations that need to be strategically handled (Hadwin et al., 2017).

Recent studies have emphasized the importance of individual students' strategic skills during collaborative learning (Järvelä & Järvenoja, 2011; Panadero & Järvelä, 2015; Panadero, Kirschner, Järvelä, Malmberg, & Järvenoja, 2015). For example, Järvelä, Järvenoja and Veermans (2008) studied the dynamics of motivation in socially shared learning from individual and group perspectives by using self-report questionnaires and video data. They found that an individual group member can have a vital role in activating a group's regulatory processes during challenging collaborative learning situations. In a subsequent study, Järvelä and colleagues (2016) used chat and trace data to investigate how different types of regulation were used during collaborative learning. Their findings showed that individual group members' regulated behavior focused more on metacognitive aspects of learning, which would be needed to start groups' social regulatory processes. In this regard, their study focused on coordinating activities, such as planning and strategy choices.

It has been shown that learning these skills is important for students (Pintrich, 2000; Zimmerman, 2011) but that teachers help is needed, especially if the students are young (Häkkinen et al., 2017). To be able to help, teachers need to know these skills too. For example, it has been shown that teacher education students in particular have a significant role in acquiring first-hand experience of these new and useful learning practices (Näykki, Pöysä-Tarhonen, Järvelä et al., 2015). Unfortunately, in the higher education context, students are required to be more independent

in their learning, and support for students' regulated behavior is not always offered. This can be a risk, particularly during challenging collaborative learning situations and especially if students lack the skills of regulation and good collaboration (Hadwin et al., 2011, 2017). For example, Ahonen, Pyhältö, Pietarinen and Soini (2015) studied teacher education students' learning experiences and found that they were not fully able to overcome the different challenges they faced during their studies and burgeoning careers; the students needed more support during their studies and when asked to work collaboratively with their peers. The provision of such support has the potential to create positive learning experiences that can affect teacher education students' professional development.

Giving a voice to individual group members in the form of interviews provides a way to understand the meaning they have of their own behavior (Seidman, 2012). Taking into account individual students' interpretations in a collaborative learning context can provide useful information about the functioning of the group and the reasons behind the decisions the group make. Combining this information with group-level process data in a teacher education context can make a research standpoint especially relevant to collaborative learning (Järvenoja, Järvelä, & Malmberg, 2015; Miyake & Kirschner, 2014) but also to the development of the teacher education, where more thought needs to be given to the type of support teacher education students need in order to learn to become better learners and future teachers (Ahonen et al., 2015; Häkkinen et al., 2017). This type of research helps in analyzing students' strategic activities in these situations and finding out their own interpretations can provide more information about students behavior and the reasons behind their activities (McCardle & Hadwin, 2015).

2. Aim

This study gives voice to individual students' reflective interpretations of the challenges they face during collaborative learning. It investigates how students describe their strategic activities to overcome these challenges and illustrates how individual group members' interpretations and actual

learning situations are interrelated. The research questions (RQs) are as follows: (RQ1) What types of challenges and strategic activities did the students identify after their collaborative group work? (RQ2) How did the students describe their strategic activities in relation to their reported challenges? (RQ3) How were the described strategic activities manifested in actual challenging situations?

3. Method

3.1. Participants and procedure

The participants in this study were second-year teacher education students ($N = 43$, 35 females and 8 males, mean age = 24.6 years) who took part in a larger research project in Finland aimed at developing the appropriate analytical methods to identify and examine the regulation of learning and to prompt teacher education students' SRL skills during collaborative learning situations. The data was collected from a didactic math course that lasted for seven weeks. This course was selected because it was one in which all second-year teacher education students participated at the same time, and the same teacher taught the course to all students, who came from three different study groups. This ensured that the research context was as similar as possible for all students.

During the course, the students worked in the same three- to five-member groups (totaling 11 groups). The course was composed of six teacher-led sessions with specific math assignments (about 90 minutes per session) and an extensive, student-led collaborative course assignment. The teacher-led sessions were structured and included three parts: 1) a five-minute news flash dealing with various topics related to cognitive, motivational and emotional self-regulated learning, 2) an introduction to the topic of the day, and 3) a collaborative group task, during which the students solved math problems given by the teacher. During the student-led sessions, the students independently planned and executed the collaborative group assignment.

Interview data. Semi-structured interviews were conducted by two researchers after the course. The interview focused on individual experiences in the collaborative group work during the course (43 interviews, 15–25 minutes each). The interviews were audio recorded and transcribed. The questions comprised two parts. First, the students were asked to describe their collaborative group work in general (evaluated on a 1–10 scale), how satisfied they were with their collaboration, and the reason for their rating (Table 1, questions 1–2). Second, they were asked to describe three challenging learning situations their group faced in their collaboration (Table 1, questions 3–8), one related to their knowledge and skills (cognition), one concerning their will and motivation (motivation) and one related to their emotions (emotion). Every student had an opportunity to describe three different challenging learning situations. The descriptions were required to be as specific and as detailed as possible. After students had described the challenging situations, they were asked to describe how their respective groups reacted to and regulated each situation.

Table 1. Interview questions analyzed for this paper.

Interview questions		Aim of the questions
Part 1	1. How satisfied were you with your group work on a scale of 1 to 10 (1= Not satisfied at all, 10= Fully satisfied)?	Overall satisfaction with the collaboration
	2. Justify your answer.	
Part 2	3. Describe one concrete example, as specifically as possible, of the type of challenge related to knowledge and skills that your group experienced.	Cognitive challenges
	4. What did you do during this challenge?	Strategic activity during cognitive challenges

5. Describe one concrete example, as specifically as possibile, of the type of challenge related to will and motivation that your group experienced.	Motivational challenges
6. What did you do during this challenge?	Strategic activity during motivational challenges
7. Describe one concrete example, as specifically as possibile, of the type of challenge related to emotions that your group experienced.	Emotional challenges
8. What did you do during this challenge?	Strategic activity during emotional challenges

Video data. All lectures and collaborative work sessions were recorded with 360-degree cameras (88 hours altogether). This study focuses on one 65-minute work session from two groups.

3.2. Data analysis

Interview data. First the transcribed interviews were coded by using theory-driven content analysis (Hsieh & Shannon, 2005). At the beginning the described cognitive, motivational and emotional challenging learning situations were categorized. At the beginning of the categorization, all similar comments were roughly assembled in the same category (e.g. “problem solving tasks were difficult”, “we were not sure what we had to do”, “we did not understand the learning materials”). This resulted in four challenge categories *task*, *interest*, *external constraints*, and *collaborative work and communication* (Table 2). Second, the descriptions of the groups’ strategic activities during the challenges were classified in terms of whether or not they included descriptions of strategic activities. The *strategic activity* code refers to situations where the students explained how their group strategically reacted to the described challenge. The *non-strategic activity* code refers to situations where the students reported that they did not try to regulate the challenging

situation, or they did not provide any description about their group's strategic activity. After this, the described strategic activities were categorized by using the labels *collaboration*, *rearranging plans and goals*, and *motivational and emotional support*. More specific and systematic categorization and statistical tests were not possible because the specificity of the students' descriptions of their groups' strategic activities varied a lot. After this, qualitative examples, to illustrate the different strategic activities during different types of cognitive, motivational and emotional challenging situations, were searched from the data.

Two independent researchers double coded all transcripts to determine interrater reliability. The reported challenging learning situations' and students strategic activities were coded separately (one coding round for each part). An almost perfect agreement was reached in the challenge-type coding ($\kappa = 0.818$), and substantial agreement was reached in the reaction coding ($\kappa = 0.727$). Finally, the contradictory findings were negotiated, and the coding principles were specified until 100% consensus was reached.

Table 2

Definitions of the challenge-type categories

Challenge type	Definition	Example
Task	Challenge that is related to task	"Problem-solving tasks were difficult."
	conditions, performing the task,	
	learning from the task	"We didn't understand what we had to do."
		"It was hard to find learning materials."
Interest	Explanations where students	"The course isn't interesting."
	highlight that their challenges are	"Mathematics isn't that interesting."

	caused by their lack of personal	
	interest in the course	
External constraints	Different challenges caused by various external constraints (timing or technical issues) that students could not affect by themselves beforehand	“Lectures just before lunch were challenging and disturbed our concentration.” “Friday afternoons were not optimal times for studying.” “The computer didn’t work.”
Work and communication	Challenging situations that are described as caused by the lack of collaborative work and communication among the group members	“We strongly disagree about the task execution.” “One group member didn’t do his part.” “Participation isn’t equal.”

Video data. Then video data was analyzed in more detail. In the beginning, two groups were chosen for the closer video analysis based on the phase 1 coding. Groups that differed the most from each other in terms of the reported strategic activities were chosen. Students from case group 1 reported only challenging learning situations, with descriptions of some strategic activity, while case group 2 had challenges with descriptions of strategic activities but also had the most descriptions, of all eleven groups, about the challenges with non-strategic activities (in 42% of cases, strategic activities were not described). To see how individual students’ interpretations corresponded to students’ behavior during actual learning situations, the video clips for closer video analysis were chosen on the basis of the individual students’ interview responses. One lecture in particular was mentioned as presenting challenges for several groups during the course, including one student from case group 1 (“When we had to use the equation scale for problem-solving tasks

... It was challenging for us”) and two students from case group 2 (“The lesson in which we had to solve equations with the scale was difficult”, “Tasks that we had to do with the scale were difficult at first”). This lecture, in which the students had to solve different equations by using the equation scale and different types of weight (different-sized blocks and teddy bears), was chosen for closer analysis. Next, the case groups’ video analysis proceeded by dividing the video clips into one-minute sequences, in which the group members’ participation was coded on a four-level scale (*No one is participating; one group member is participating; some group members are participating, and all group members are participating*). The requirement for participation was each group member’s active involvement in the group discussion by asking questions, sharing his or her own opinion with the others, or offering new suggestions. If some group members were just listening quietly while others were talking, just nodding and agreeing with others, or doing their own tasks and discussing off-topic issues with someone, they were not considered as actively participating in the collaboration in the one-minute segment. After this, the moments when there were clear visible signs of the group becoming aware of a challenge were searched. These situations included moments when a member verbally indicated some challenges in the group’s work, or another clear sign showed that the group members were required to make changes to their work (e.g., Student 1: “No... Our result can’t be right because the scale is unbalanced.” Student 2: “I was thinking also that can we really do it like this.”). After the challenging learning situations were identified, it was observed in detail how the students participated and reacted during these situations and how different ways of strategic activities and participation were affecting the progress of the collaboration. These have been reported qualitatively with case examples.

4. Results

4.1 What types of challenges and strategic activities did the students identify after their collaborative group work?

During the interviews, students described 109 different challenging learning situations. The most commonly described were cognitive ($f = 40$, 36.7%) and motivational ($f = 39$, 35.8%) challenges. Emotional learning challenges were mentioned less frequently ($f = 30$, 27.5%). Strategic activities were reported more often during challenging situations that students experienced as cognitive challenges (only 12.5% of the situations were reported as left unsolved) and less often during situations that were experienced as emotional challenges (33% of the situations were reported as left unsolved) (Figure 1).

Figure 1. Distribution of described versus undescribed strategic activity in relation to cognitive, motivational and emotional challenges.

4.2 How did the students describe their strategic activities in relation to their reported challenges?

Strategic activities during cognitive learning challenges. With regard to cognitive learning challenges, students experienced task-related issues more often ($f = 35$, 87.5%) than interest ($f = 1$, 2.5%), external constraints ($f = 2$, 5.0%) and collaborative work and communication ($f = 2$, 5.0%). Strategic activities were described for 87.5% ($f = 35$) of these situations. Task-related challenges in

these situations were usually reported as being solved by working together, helping each other and constructing a common understanding about task-related issues through open and active group discussions. In addition, rearranging practical matters was mentioned, e.g. doing active planning and changing plans and goals. Challenging situations that were related to external constraints, interest and collaborative work and communication were not usually mentioned with a description of strategic activities when they were experienced as cognitive challenges. When strategic activities were described, students found that motivational and emotional support and good group spirit and collaboration helped them to face these challenges.

Table 3.

Students' strategic activities during cognitive challenges

Challenge type	Described cognitive challenge	Described strategic activity	Strategic activity
Task	“All problem-solving tasks were challenging for us.”	“We worked together. First we discussed what the task was asking us to do and what we already knew. Then someone shared their idea. We tested it, and if it did not work, we found another solution together.”	Collaboration
Task	“Reading books written in English was a challenge for us. We were not sure that we had understood the text correctly.”	“A group member who was good at English read the text aloud for all of us and translated the text. Others made notes in Finnish. We then shared the responsibilities among all the group members,	Rearranging practical matters

and it was agreed that next time
everyone would teach their own
part to the others.”

Strategic activities during motivational learning challenges. With regard to motivational challenges, the students mostly experienced external constraints ($f = 21$, 53.8%) but student interest ($f = 8$, 20.5%), task-related issues ($f = 6$, 15.4%) and collaborative learning and communication ($f = 4$, 10.3%) were also mentioned. Strategic activities were described for 79.5% ($f = 31$) of these situations. During motivational challenges caused by different task-related issues, students described a wide range of strategic activities. Students found that good collaboration, rearranging practical matters (such as active planning) and motivational and emotional support helped them to face these types of challenge. Challenging situations caused by the lack of individual group members' interest in the course and/or learning tasks were usually solved through active planning and cognitive strategic activities. When the motivational challenge was caused by different external constraints, the students felt that the supportive atmosphere in the group was helpful in coping with these situations as it supported students motivation regulation processes (such as highlighting the positive side of a situation, cheering up one another, raising the group's feeling of efficacy). In some situations, a leader in the group helped students to engage with the work, and this was also experienced as reducing students' small motivational challenges. When challenges were related to students' collaborative work and communication, motivational and emotional support in particular were experienced as being important in solving this type of challenge. However, this support was not always forthcoming immediately upon the challenge being identified; sometimes it was found to be useful to wait until the situation calmed down a little bit.

Table 4.

Students' strategic activities during motivational challenges

Challenge type	Described cognitive challenge	Described strategic activity	Strategic activity
External constraints	“It is sometimes really hard for us to concentrate in morning lessons.”	“We try to motivate each other with humour and positive thinking. Someone then takes the lead and we start working. Once we have started working, it gets easier.”	Motivational and emotional support
Collaborative group work and communication	“There was one member who we could not get to participate in the first lecture. She was just sitting quietly and looking desperate. At the end of the lecture, she said that she probably did not want to participate at all.”	“We tried to cheer her up at first by saying that things feel hard at first. In the next lecture, we talked to her again, and she said that she was having a bad day on the previous occasion. We cheered her up again by telling her that everything would go well and that she could do it.”	Motivational and emotional support

Strategic activities during emotional learning challenges. Emotional challenges were mostly related to external constraints ($f = 14$, 46.7%), followed by challenges related to their collaborative group work and communication ($f=8$, 26.7%), learning tasks ($f = 4$, 13.3%), and individual students' interest ($f = 4$, 13.3%). Strategic activities were described for 66.7% ($f = 20$) of these situations. Regardless of the challenge types experienced, most students described strategic activities related to motivational and emotional support. This support was described in many ways. In some situations, it involved cheering each other up by raising group members' self-efficacy

beliefs or using humour to help students to overcome negative thoughts. Overall, these descriptions brought up the open atmosphere and the positive team spirit that were experienced as enabling motivational and emotional support, which also helped students to regulate their learning in better ways.

Table 5.

Students' strategic activities during emotional challenges

Challenge type	Described cognitive challenge	Described strategic activity	Strategic activity
Interest	<p>“There was quite a lot of frustration and I personally felt that this course did not represent my strongest competencies. I was irritated because I was not good enough.”</p>	<p>“Humour was our thing. We joked a lot, and then the others helped me by giving extra advice.”</p>	<p>Collaboration</p> <p>Motivational and emotional support</p>
External constraints	<p>“I think that it was every time we had to answer that questionnaire with the iPad. It was frustrating because it never worked like it should.”</p>	<p>“We cheer up one another, saying, “Soon, this lecture will be over, and we can have lunch.”</p> <p>“We can do this.”</p>	<p>Motivational and emotional support</p>

Challenges without description of the strategic activity. Individual group members usually described a non-strategic activity by saying, “We just continued our work” and “we didn’t exert any effort for this problem.” These were usually situations in which the challenges were related to students’ emotions and motivations, which were mostly connected to students’ collaborative work

and communication or external constraints. However, in some descriptions, the students gave explanations for their non-strategic activities. For example, when the challenges were caused by some external constraints, students felt like it was not in their responsibility to use their time to solve the challenge they were encountering. This was especially the case when the faced challenges were related some technological difficulties. Additionally, individual students' roles were brought up several times when the reasons for the non-strategic activities were given. This was especially the case when the challenges experienced were related to individual students' interest or personal emotional problems. Either individual group members independently used a strategic activity to solve a challenge without elaborating on this situation with other group members, or it was expected that all were independently taking care of their encountered challenges. The students also described that in some cases, they considered it not worthwhile to focus on (solving) the problems at the expense of slowing down the task execution. This was especially the case with the problems related to collaborative work and communication.

4.3. How were the described strategic activities manifested in actual challenging situations?

The cases below show what individual group members' interpretations of their collaborative group work tell us and how they correspond to actual learning situations. This is done by combining individual-level interview data with the video data; an episode of a challenging situation in each of the two case groups was selected to illustrate in more detail how each group's strategic activity or the lack of it in a challenging situation influenced the group's learning and collaboration in practice. The analysis focused on the group members' strategic activities during a challenging learning task. Both case examples are derived from a lecture where the groups had to collaboratively solve different equations by using an equation scale and two types of weights (blocks with known weights and teddy bears with unknown weights).

Case 1. This group was composed of three students: Ari (male), Maija, and Sonja (females).

On the basis of the interviews, it seems that these students succeeded in making realistic and achievable plans and goals to which all members of the group were committed. The challenges that the students described were caused by different task-related issues and external constraints, which challenged their cognitive abilities, motivations and emotions in different ways. The challenging learning situations were reported as being solved by strategic activities that highlighted not only good collaboration, which saw students discuss a great deal and construct a common understanding about task instruction and learning tasks, but also good strategic skills, supporting each other's motivational and emotional states and setting realistic and achievable goals and plans for group working. All the above led to the group members being equally satisfied with their work during the course, each recording a satisfaction level of 9 or above. (Table 6).

Table 6. Students individual interpretations in case group 1

Student	Described challenges	Strategic activity	Satisfaction	Description about the collaborative group work
Ari	C: Task	Collaboration	9,5	We had a realistic goals and we all engage to fullfil them. We shared some of the tasks but we also discussed a lot, and planned everything together. I don't have anything bad to say.
	M: External	Planning		
	E: No challenge	-		
Maija	C: Task	Collaboration	10-	At the beginning we planned our work and agreed that all are participating. Participation has been equal and everything has went very well. We have worked as a group and everyone were listenet to when we were doing decisions. Atleast I have had feeling that all were satisfied to our working.
	M: Task	Planning & goal setting		
	E: Task	Motivational & Emotional support		

Sonja	C: Task	Collaboration	9	Everything was planned together. Our
	M: External	Motivational &		collaboration worked very well and all were
		Emotional support		doing their own part. We were engaging to the
	E: External	Collaboration		goals and plans we did at the beginning.

Video analysis shows how this group worked on the equation scale task for a total of 30 minutes. Overall, this group succeeded in keeping all its members' focus on the learning task most of the time, and their focused work periods continued uninterrupted for several minutes (totaling 22 minutes in a 30-minute session). During this session, students faced six (6) different challenging situations, and on each occasion strategic activities of some sort were shown to resolve the problem (Figure 2).

Figure 2. Identified challenges and participation in case group 1. EA = Example A, EB = Example B, EC = Example C, ED = Example D.

The first challenge was encountered almost immediately after the group started working, and it was cognitive in nature. The challenge appeared when the students were trying to solve equation $2 + x = 6$ by using the equation scale and two types of weights (blocks and different sizes of teddy bears). The challenge was identified when the students saw that they could not manage to balance the scale, which indicated that there had to be a mistake in their original hypothesis (Example A).

Example A

Ari: There are not enough [teddy bears] (*starts to move the teddy bears on a scale*). One, two, three, four, five, six...

Maija: The scale doesn't go down ever.

Ari: Seven, eight... No, these are not enough.

Maija: ... nine (*throws one more teddy bear on the scale, but the result is not what the group is expecting*).

This moment is a typical example of a situation where the group members realized and made it explicit that they were facing a (cognitive) challenge in the group. By saying aloud the problem, the students were making sure that they were all aware of the situation; their hypothesis was not working, and they needed to figure out something else. As a result, the group members showed a strategic activity by starting to elaborate on what went wrong and what to do differently to obtain the correct answer. They then started to test their new hypothesis accordingly.

Example A (continued)

Ari: We should have used a different type of teddy bear.

Sonja: Are we using the right teddy bears?

Ari: We should use the medium-sized teddy bears [instead of the large ones].

Sonja: Well, should we try those medium-sized teddy bears then?

Maija: Yes, because the ones we used were too heavy.

After recognizing and addressing the challenge, all the group members actively engaged in collaborative problem solving by exchanging ideas and suggestions for several minutes before facing any new challenge. However, the same learning task continued to challenge them, and failing repeatedly in the task seemed to frustrate them. Maija opened the discussion about their emotional challenges by sharing her own feelings.

Example B

Maija: I am irritated because I am hungry.

(Ari is throwing new teddy bears on the scale.)

Sonja: Well, now it is balanced *(fixing the scale)*.

(Ari is taking one teddy bear weight out of the scale, and all are looking together if the scale is becoming balanced.)

Ari: Now there are two small teddy bears on the scale. But it can't be right.

(Sonja laughs.)

Maija: We don't have enough teddy bears! *(looking frustrated and raising her voice)*

Ari: Teddy bears are stupid.

Maija: But we don't have enough teddy bears.

Sonja: Should we ask if we can get more teddy bears? Is the teacher just randomly using these different weights?

Ari: No... *(sounds frustrated and continues working with Maija)*

It seemed that the open atmosphere in the group made the members feel secure enough to share their emotional problems. This helped them strategically react to an emotional learning challenge (Example B). When Maija shared her frustration, she received social support from Ari and Sonja (Ari: “Teddy bears are stupid.” Sonja: “Should we ask if we can get more teddy bears?”). By offering socio-emotional support to Maija, Ari and Sonja managed to persist in their trial-and-error type of working. However, their persistence did not lead to a correct answer. Ari gradually became impatient, causing challenges in the group’s collaborative work and communication. Ari started working alone without verbalizing his thoughts, which caused Maija difficulties in following the process with the equation scale and the weights (Example C).

Example C

Maija: It does not move even a bit.... How come it can’t go right?

Ari: *(Decides to throw a new teddy bear on the scale)* Six. No.... We are out of teddy bears.

Six and one more *(throws a new teddy bear on the scale)*.

Maija: Ari, you messed it again. We have to be logical now. What did you throw in there?

(looks at the scale)

Sonja: That big one.

Maija: That is right because there is now.... Our answer is still not correct.

Sonja: It is just not right.

Ari: It is $2 + x = 6$, meaning that there should be six something on the other side of the scale.

Sonja: Yes.

Maija: Yes, on that side, there should be six medium-sized teddy bears.

(Knowledge construction is continuing among them as a whole group.)

Again, by initiating explicitly that there was a need to change the group's behavior, Maija managed to get the group back on track. Ari started to collaborate with the others again; as a result, the group continued persistently in their work.

Toward the end of the task, the group encountered a new type of cognitive challenge when Sonja had a problem with understanding what the others were doing and why. Sonja felt secure enough to state this fact explicitly. Thus, Maija briefly explained what they were doing and the reason for it, but Sonja still did not fully understand the process (Example D).

Example D (time sequence 22)

Sonja: I don't understand (*laughing*).

Maija: Well, by doing this [referring to their way to solve the task], we have just proven that this equation is true. So the [single] teddy bear is [equal to] eight [blocks].

Sonja: Mmm...

Maija: It means that the equation is true.

Sonja: Ok... (*hesitantly*).

In contrast to the previous challenging situations, this time, strategic activities (clarifying Maija's and Ari's way of working with Sonja) were insufficient to solve the challenge in a way that would restore Sonja's engagement. Despite Maija's efforts to clarify and explain the process, Sonja was still struggling to follow what they were doing. This resulted in her disengagement for almost the rest of the time.

In sum, this group employed a task-focused way of working. This group seemed to manage to bring out and share the challenges they faced during their collaboration. Strategic activities were used to solve the challenging situations. This process was visible, not only in the case example, but also in the interviews where the students mostly described their task-related goals and task-related

learning challenges. The case analysis showed that strategic activities were also activated in relation to the challenges concerning the students' interest or collaborative work and communication. The challenges were usually handled quickly, even when the effects of the students' frustration were visible. This type of strategic activity worked well, probably because of the positive team spirit and constructive collaboration, which were visible in both the case example and the individual students' interview responses.

Case 2. Five students—Saija, Hanna, Teija, Mari and Tarja (all females) belonged to this group. Four of them participated in the interviews (Saija, Hanna, Teija and Tarja), and four of them (Saija, Hanna, Teija and Mari) were present at the lectures that were selected for video analysis. On the basis of the interviews, it seems that these students had differing expectations and ideas about their collaboration. Nonetheless, they reported that their work together was mostly good, and they managed to discuss and organize their work in such a way that they were able to get the tasks done, even though they had some difficulties while working. The challenges described also showed variation among the group members. Challenges related to external constraints were reported most frequently but challenges related to the learning tasks, students' interest and collaborative work and communication were also highlighted. Of the challenges reported, 2/3 of situations were described as having been solved by collaborating with each other (helping each other and discussing challenging issues), rearranging plans or giving motivational and emotional support to each other. However, the students also reported that in 1/3 of the situations, they did not do anything to respond to the challenges they faced, and just let things be. As a result, the group members were satisfied to different degrees with their collaborative group work, scoring their satisfaction in the range of the 7 to 9.5 on the scale (Table 7).

Table 7. Students' individual interpretations in case group 2

Student	Described challenges	Strategic activity	Satisfaction	Description about the collaborative group work
Saija	C: Task	Collaboration	9	We have been working together but also shared some resbonsibilities. From my opinion working have worked well, and if some one couldn't participate she did some tasks alone at home. We also didn't have any big conflicts or fights. Everyone's participation have been equal.
	M: External	Nothing		
	E: External	Collaboration		
Hanna	C: External	Collaboration and motivational & emotional support	7,5	We had a lot technological problems, and it was hard to get started at first, but after we get over that working have been ok. Also finding a common schedule for working was challenging. These type of things started to irritate me a little bit. But we still worked together very well.
	M: External	Planning		
	E: External	Motivational & emotional support		
Teija	C: Task	Collaboration	9,5	Working together was nice, and we had open atmosphere in our group, but using different technological equipments was frustrating. I don't have anything bad to say, everyone were really hard-working. And if we were having difficulties we could ask help from each others.
	M: External	Nothing		
	E: External	Nothing		
Tarja (Not present in the video)	C: Interest	Motivational & Emotional support	7	I don't think that our working was real collaboration. Some parts we have discussed with the group and some parts we have done individually. Finding common time for working was big challenge for us because we had a big group and all were not interested about the course. I expected more about our working, for example reading scientific papers is part of the
	M: Interest	Nothing		
	E: Collaborative group work and communication	Nothing		

university studies, and some group members didn't want to do it.

Mari (did not participate to the interviews)

Video analysis shows that the students were working on the equation scale task for a total of 35 minutes. The instances when all the group members were participating simultaneously were rare, lasting only from one to three minutes per situation (totaling only 10 minutes out of the 35-minute session, see Figure 3). Students in this group faced nine (9) different challenging situations, and in most of them strategic activities were shown to solve these situations. However, in some situations, the challenges were registered but not given attention or strategically solved.

Figure 3. Identified challenges and participation in case group 2. EE = Example E, EF = Example F, EG = Example G.

This group started to face challenges from the very beginning of the collaborative problem solving. After three minutes of working, the members identified a cognitive challenge; they expressed contradictory opinions about how to solve the equation $2 + x = 6$. This emerged in the

situation where Hanna and Saija started to formulate a hypothesis about how they should solve the task, and Mari was arguing that she would do the task in a different way (Example E).

Example E

Mari: I would do this differently.... Whatever.

Hanna: How would you do this?

Mari: Well, I would.... I don't understand why x is a small teddy bear. I would do it so that here are two weights and here are six, and then, I would start to add those weights until the scale is balanced.

Hanna: Yes. So should we now put this on the scale (*talking to Saija and pointing at the small teddy bear*) because it is the x ?

Saija: Yes, we have to use the small teddy bears.

Despite the recognizable challenge, the group members did not state it clearly, with the result that there was no intentional strategic activity to solve the challenge. The group heard Mari's differing idea but paid no attention to it, and Hanna and Saija continued their original idea without discussing it with the others. At some point teacher ends up to help students with the task. Despite the teacher's help, the group still struggled to understand the task, causing feelings of frustration and confusion among several group members (Example F).

Example F

Teija: I wouldn't do it like this.

Mari: I'm really confused...

Teija: So confused... I know how to solve equations in the normal way, and I think that there are better ways to demonstrate this. This way is too confusing.

Saija: I think... Now I...

Hanna: I understood it, too.

Saija: ...understood this. I could try to test this with the kids at school.

Hanna: This is really a simple thing if you understand it.

Mari: Well, I understand it now, but it took too much effort to start to understand...

Teija: Yes.

Mari: It just took too much time. I was thinking that the bear is unknown that...

Saija: At first, it actually was.

Mari: Yes, but it was unknown by the teacher, too. I just couldn't understand what the meaning of the teddy bear was.

Teija: But let's [proceed with] the third task.

In Example F Mari and Teija were sharing their feelings of frustration with the others. Saija and Hanna were trying to offer quick social support to Mari and Teija by highlighting the positive side of the task (e.g., "This is really a simple thing"). However, this does not solve this situation, and Mari's and Teija's emotional and motivational challenges were negatively affecting the group's work for the rest of the learning session by causing unequal participation and problems with the members' collaboration. Hanna and Saija ignored these challenges, focusing on doing the learning tasks.

At some point, Mari was showing her interest in the learning task by bringing up a new challenge, this time a cognitive one; she did not understand how Saija and Hanna solved the task (Example G).

Example G

Mari: I am not understanding it now.

Hanna: If I start from the beginning again, will that help you? Saija, can you put the bears and the blocks on the scale?

Saija: OK. Wait a second (*putting the weights on the scale*).

Mari: I missed the last phase.

Hanna: OK. So the first phase was that we removed two teddy bears from both sides.

Saija: ...it is $-2Y$.

Mari: OK.

Hanna: So how you wrote it down?

Saija: Like this. Add two lines and put $2Y$ (*showing her own notes to Hanna*).

Hanna: How you wrote the equation then?

Saija: $Y + 2 = 10$. Did you get the same?

Mari: Yes.

Hanna: Did you say $Y + 2 = 10$?

Saija: Yes. Then...

Hanna: -2 .

Saija: Yes. -2 from both sides.

Hanna: And then we get the answer $Y = 10 - 2$, which gives $Y = 8$. Tadaa!

(*The others are quietly taking notes.*)

Hanna: Do you understand now?

Mari: Yes...

Teija: I am just tired.... I'm sorry.

Bringing this challenge into question seemed to play an important role. Saija and Hanna were finally listening to Mari and also showing the strategic activity to address the problem by explaining

to Mari and Teija how the task was done. By doing so, Saija and Hanna succeeded in engaging Mari to collaborate with them for the rest of the time.

In sum, based on the video analysis, it can be concluded that this group clearly had two types of challenges in their work. The first involved cognitive challenges related to the learning task. The group members were showing strategic adaptation in relation to this type of challenge, such as checking the task instructions again or discussing different ways of doing the task. The second type of challenge was related to interest. The group members' actions did not indicate attempts to address this situation, or if someone indicated this type of challenge, she was typically ignored by the other members, causing further challenges in the group's collaborative work and communication. Overall, these issues resulted in low and unequal participation, as well as interactions in which the other group members' comments and suggestions were ignored. This can explain why all students were not that satisfied about their respective groups' work during the course, as reported in the interviews. The interviews especially showed how the group members had different requirements for their collaboration. While some students were really happy with their work, others were disappointed and missed more real collaboration where the students discussed and performed the tasks together instead of dividing the tasks among themselves.

5. Discussion

This study investigated individual students' self-reported challenges encountered during collaborative learning task and individual students' interpretations of the group's strategic activities during challenging collaborative learning situations. In addition, this study provided two case examples of such challenges that could be traced to the actual learning situation to illustrate how the described challenges and strategic activities were emerging in group members' interactions and behavior in the actual learning situations.

This study showed that strategic activities were especially described in cognitive and motivational learning challenges. Fewer strategic activities were identified in relation to the

emotional challenges. Also former research has shown that the requirements of collaborative group work encouraged the students to keep their focus on task related cognitive aspects (Janssen et al., 2012). The less frequent reports concerning the strategic behavior in relation to the emotional challenges could also indicate the students' inability to identify and hurdle the motivational and emotional challenges that they were facing since earlier research showed that those challenges were hard to recognize by the students themselves (Järvenoja, Järvelä, & Malmberg, 2015; Winne & Hadwin, 2008). Finally, earlier studies have indicated that "to do nothing" to control the challenges could also be strategic decision on a group level; the group as a whole can choose to ignore the emotional challenge if it is not endangering the learning process (Volet, Summers, et al., 2009; Volet, Vauras, et al., 2009). For example, in this study it was reported that especially individual emotional issues were left for individual to solve alone without. In addition, this study found evidence about the students' non-strategic activity in collaborative learning in relation to the motivational challenges. Especially that were related to the external constraints or collaborative work and communication, were not strategically addressed that often. This can reflect that students did not want or were not having enough means to solve these situations and as a consequence they were left unsolved. In the interviews, the students justified these decisions explaining that they did not want to use their collaborative working time to address explicitly these challenges. In some responses the students also indicated that they did not have means to solve the encountered challenges, especially if the challenges were caused by different external factors. However, while it may appear functional in the situation, not engaging in strategic regulation and sharing the strategic decisions with other group members can cause harm to the groups functioning in the long run and prevent the group members from gaining the possible benefits from their collaboration. Scager et al. (2016) studied higher education students' experiences during successful collaborative learning and found that students in successful collaborative groups emphasized the meaning social support from their peers in the phase of difficulties. In addition to this, Barron (2003) noted that a joint

focus on the encountered learning challenges could make a difference between successful and unsuccessful collaborative groups. Especially, facing emotional or motivational challenges requires a socio-emotionally secure atmosphere and a positive socio-emotional interaction among the group members (Kempler Rogat & Linnenbrink-Garcia, 2011) and this can contribute to group learning success (Saab, 2012). This was also observable in the case illustration of this study, which so how in less functional group, the group members did not engage in....

Finally, the results of this study indicate that individual students' experiences about their collaboration mirror groups' challenges they are having in their collaboration but are also giving reasons for the challenges groups were having while they learning. Previous studies have already shown how individual group members' strategic skills play a vital role in activating groups' shared regulatory processes (Järvelä et al., 2008; Kempler Rogat & Linnenbrink-Garcia, 2011; Panadero & Järvelä, 2015), and how interactive and argumentative processes between individual group members are connected to students' participation (Isohätälä et al., 2017) as well as to the general work atmosphere in the group (Barron, 2003; Janssen et al., 2012; Van de Bossche et al., 2006; Webb et al., 2006). This study also contributes to the field by showing individual students' subjective interpretations of the experienced challenges and describe their own explanations and reasons for the strategic behavior or the lack of it and tries to illustrate how individual perceptions are an important part of the collaborative learning. It shows how unsolved challenges can contribute in different ways to the groups' collaborative learning. Unaddressed challenges may create a series of new challenges, as both case examples were illustrating. When the students were repeatedly failing to solve the cognitive challenges caused by their learning task, it led to emerging challenges that were motivational and emotional in nature.

This study's limitations included dealing with the nuances of semi-structured interviews since the students' response styles varied a lot. This issue created challenges when the coding categories were formed. However, in the interviews, the students were able to reveal their individual voices

and the silent information that were not always possible to observe from the video data. The small sample size and the contextualized research setting do not allow generalization of the findings.

However, complementary information about the challenging details of collaborative learning was obtained.

6. Conclusion

This study points out the importance of investigating individual student interpretations of the challenges they encounter as part of collaborative learning and as confirming and complementing actual process data (videos in this case). While process data can reveal the actualized regulatory behaviours taking place during collaborative group work, it doesn't reach individual group members beliefs and self-perceptions that set a state for collaboration (Hadwin, Järvelä, & Miller, 2018). Giving the individual group members a voice in the form of interviews provides a way to understand the meaning of students' behavior (Seidman, 2006). This is an important addition since students' own judgments regarding their behavior are not always observable outside (McCardel & Hadwin, 2015), which make it difficult to make accurate assumptions based solely on students' behavior.

In practice, the results point out how teacher education students' strategic learning skills play an important role in overcoming challenges in collaborative learning situations. This study supports the results from a previous study by Ahonen and colleagues (2015) emphasising that teacher education students need support in developing their strategic skills, especially, in learning how the different types of challenging situations can be handled with strategic activities, so that they are ready to guide their becoming students in these processes. However, this requires more accurate and real-time support for students' collaborative learning, helping them create a positive and respectful atmosphere in the group (Laal, 2012), as well as enabling them to identify and hurdle the challenges they face in their studies (Järvelä et al., 2016; Järvelä et al., 2015). Only when the future teachers are skillful enough to regulate their learning and collaboration, they are able to provide support for

their student in strategic, self-regulated learning. These skills should be practiced by students with their teachers' support as early as the primary school level. Developing these skills in the early years of school helps students advance to higher educational levels where they are required to study more independently and take responsibility for their own learning (Häkkinen et al., 2017).

Since collaborative learning is increasingly applied in educational contexts ranging from primary school to higher education, further research is needed to understand both individual- and group-level perspectives to make collaborative learning a more efficient way of studying for all the students regardless of their age (Panadero & Järvelä, 2015). Several questions remain to be answered, such as how individual students' experiences affect collaboration, what function external support performs to help groups identify and overcome the challenges they encounter, and how groups can be supported at individual and socially shared collaborative interaction levels. However, this study highlights that in order to reach a comprehensive understanding of the collaborative learning challenges, we need to consider both the sides; the individual, subjective perceptions of the strategic activity as well as the data of the actualized behaviours in the situation.

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Appendix 1.

Equation scale tasks

1	Show with the scale the meaning of the concept equality
2	Solve the equation $2+x=6$ by using equation scale. In this task x is small teddy bear
3	Use the scale and show that a) you can add to both size the same numberb) you can reduce from the both size the same numberc) you can multiply both size with the same numberd) you can divide both size with the same number
4	Solve next tasks with the equation scale step by step a) $3y+2=2y+10$, here y is middle size teddy bearb) $\frac{1}{3}x+x+4=\frac{2}{3}x+12$, here $\frac{1}{3}x$ is small teddy bear, $\frac{2}{3}x$ is middle size teddy bear and x is big teddy bear
5	Discuss what are the limitations of the equation scale.
6	Discuss what pedagogical and didactical information this learning session gave to your group
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