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THE TYPES OF STUDENTS' EMOTION EXPRESSIONS IN COLLABORATIVE LEARNING

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**Thesis abstract**

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**Abstract**

Motivation and emotion are key components of collaborative learning. However, there is lack of empirical studies on socio-emotional aspects in collaborative learning.

The aim of this study was to explore different types of emotion expressions in collaborative learning and the ways (verbal and nonverbal) students expressed their emotions. The participants of this study were 2 groups of first-year teacher education students from Oulu University in 2015. This study used video data which was collected from mathematic didactics course. The course took place in a classroom-like research space with 360 degree cameras and individual microphones for each participant. Altogether, there were 11 videos in total. The data was analyzed with Nvivo software to code 21 different types of emotions and verbal and nonverbal ways that students used to express their emotions.

The results showed that the students expressed 21 different types of negative and positive emotions during their collaborative learning. The main types of emotion expressions in collaborative learning of this study were calmness, happiness, boredom, and tiredness. Furthermore, it was found that confusion was expressed more often with verbal expression while calmness was expressed more often with nonverbal expression.

These findings implicate that future research can focus on how to help students to foster activated positive emotions to make collaborative learning more effective. Another interesting topic is to investigate the function of different types of emotions in collaborative learning. Besides, these findings have the potential to help teachers to design a better face-to-face collaborative learning course or computer supported collaborative learning course.

**Keywords** Emotion, Collaborative learning, Positive emotions, Negative emotions, Video data



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## 1. INTRODUCTION

Motivation and emotion are the key components of successful collaborative learning (Thompson & Fine, 1999). Less successful groups experience more social-emotional challenges due to, for example, lack of communicating, or low interpersonal dynamics (Barron, 2003). Emotional challenges can also be created during collaborative learning due to personal priorities, work and communication, teamwork, collaboration, and external constraints. Students must overcome these emotional challenges to maintain meaningful engagement in the learning process and interactions with other group members (Järvenoja and Järvelä, 2009).

Prior studies indicate that there is a clear connection between individual's emotions and their learning and achievement (Pekrun, Goetz, Titz, Wu & Perry, 2002). Most of the studies focused on negative emotions, especially test anxiety while a very few studies focused on positive emotions (Pekrun et al., 2002). However, empirical research on students' emotions in group work is surprisingly scarce (Linnenbrink-Garcia, Rogat, & Koskey, 2011). And particularly there is only a very few studies focusing on socio-emotional aspects in collaborative learning (Zschocke, Wosnitza, & Bürger, 2016).

The prior researches have explored emotion measurement, emotion detection in E-learning, ways of emotional expression, and emotion regulation (Pekrun et al 2002; Binali, Wu, & Potdar 2009; Lee, 2011; Berry & Pennebaker 1993; Russell, Bachorowski, & Fernández-Dols, 2003; Fox & Calkins 2003; Järvenoja & Järvelä 2009). Pekrun and his colleagues have developed a self-report instrument to measure students' emotion expressions of enjoyment, hope, pride, relief, anger, anxiety, shame, hopelessness, and boredom, which has been named as Academic Emotions Questionnaire (AEQ) (Pekrun et al., 2002). Followed by this study, Achievement Emotions questionnaire has been created to assess students' achievement emotions, which measures students' 9 emotions of enjoyment, hope, pride, relief, anger, anxiety, shame, hopelessness, and boredom from 24 scales (Goetz, Frenzel, Barchfeld & Perry, 2011). Emotion detection has also been reported by using opinion mining techniques in E-learning context. This study collected data from the online learning students and then analyzed the text to find containing emotions (Binali, Wu, & Potdar, 2009). Lee (2011) depicted more from the relation between emotion, emotion intelligence and E-learning. It also reported some emo-

tional sensitive instructional strategies and design to foster deeper learning (Lee, 2011). Emotions can be expressed in verbal and nonverbal ways (Berry & Pennebaker 1993). Russell with colleagues (Russell, Bachorowski, & Fernández-Dols, 2003) did a research on vocal and facial expression from the sender and receiver perspectives of emotion expressions, which showed that the expressions affected the receivers in a lot of ways. For example, emotion expressions alter receivers' state, alter the course of social interaction (influencing the degree of cooperation, submission, or antagonism in interaction) and alter activation (Russell et al., 2003). Fox and Calkins (2003) advocated in their study that self-control emotion could be developed in a very early age through implicating intrinsic factors and extrinsic factors. Järvenoja and Järvelä (2009) have focused on the emotion regulation in collaborative learning situations. The results of their study (Järvenoja & Järvelä, 2009) showed that students can regulate their emotions collaboratively as well as individually when social challenges evoked them.

The prior studies about emotion in collaborative learning groups focused more on the sources of emotional experience and emotion control (Järvenoja & Järvelä, 2005; Järvenoja & Järvelä, 2009). Later, the relationship between emotion and engagement had also been researched (Linnenbrink-Garcia, Rogat & Koskey, 2011). After that, social-emotional conflicts and the emotional reactions were discussed (Näykki, Järvelä, Kirschner & Järvenoja, 2014). Recently, the relationship between individual differences in group work appraisals and emotions arising in real-life group assignments were disentangled (Zschocke, Wosnitza & Bürger, 2016). However, the types of emotion expressions in collaborative learning haven't been investigated as a topic alone. Normally, the types of emotion expressions just appeared as a small part of a research topic (Järvenoja & Järvelä, 2005; Järvenoja & Järvelä, 2009; Linnenbrink-Garcia et al., 2011; Näykki et al., 2014; Zschocke et al., 2016). Therefore, it's needed to do a research which is just concentrating on the types of emotion expressions in collaborative learning groups to get a more comprehensive picture of it. The present study will clearly point out the types of emotion expressions.

The present study explored what types of emotions students expressed during their collaborative learning and the ways students expressed different types of emotions by verbal communication or non-verbal communication during their collaborative learning. This study used qualitative methods to analyze the video data of group interactions. At first, the theoretical back-



ground is introduced, which includes collaborative learning and emotion expressions in collaborative learning (positive emotions in collaborative learning and negative emotions in collaborative learning).

## 2. COLLABORATIVE LEARNING

Collaborative learning refers to two or more people (a pair, a small group, a class, a community, or a society) learn a course, perform learning activities, or have lifelong learning practice through different forms of social interactions (face-to face or computer supported online learning) toward a common goal (Dillenbourg, 1999). Kreijns with colleagues argues that collaborative learning is active, in which the teacher is a facilitator, students participate in small-group activities and take the responsibility for their learning (Kreijns, Kirschner, & Jochems, 2003). During collaborative learning, different types of interactions are expected, such as interactions between teachers and students or interactions between peers (Dillenbourg, 1999). However, the expected interactions may not always occur (Dillenbourg, 1999). Dillenbourg (1999) have suggested some ways to increase the probability of interaction to occur. The first is to set up initial conditions. The second is to over-specify the collaboration contract with a scenario based on roles. The third is to scaffold productive interactions by encompassing interaction rules in the medium. The fourth is to monitor and regulate the interactions (Dillenbourg, 1999). In traditional learning, there are mainly instructor-learner interactions instead of interactions between the students while in collaborative learning the educators are mainly facilitators who support the groups to achieve their common goal through social interactions (McInerney & Roberts, 2004).

Cooperative learning is a term which is very close to collaborative learning (Dillenbourg, 1999). People often get confused with these overlapping concepts (Panitz, 1999). Dillenbourg (1999) highlights that the concepts of cooperation and collaboration are sometimes used as synonymous terms. To differentiate the two concepts, some researchers use the degree of division of labor in groups. In collaborative learning, group members have common goal and they do the work together in collaboration, whereas in cooperative learning, group members split their task and then solve the sub-tasks individually and after that they assemble all the group members' results together to get the final results (Dillenbourg, 1999). Panitz (1999) emphasizes different issues in these two concepts. In collaborative learning, Panitz states that group members are responsible for their actions, should respect each other and highlight individual ability and contributions while in cooperation, groups are gathered to accomplish a specific product or a goal (Panitz, 1999).

Collaborative learning research has changed and developed all the time (Dillenbourg, Baker, Blaye & O'Malley, 1995). At first, collaborative learning research focused more on individual learning in a group level (Dillenbourg et al., 1995). After that researchers started to pay more attention on the analysis of group itself. Empirical studies were focused on doing research on several independent variables (size of the group, composition of the group, nature of the task, communication media and so on) to evaluate how to make collaborative learning more effective, but the variables were interacting with each other, so it was impossible to establish the links between the variables and effective collaborative learning (Dillenbourg et al., 1995).

Then the researchers started to explore the role that different variables were playing in interactions (Dillenbourg et al, 1995). Started from 1990 to 1995, the computer-supported collaborative learning (CSCL) emerged with the development of educational technology. In this period, people paid more attention on co-construction of a shared understanding and realized that if designed the CSCL environment carefully, it would facilitate social interactions. From 1995 to 2005, it's the second age of CSCL. In this period, scientific community developed expertise for social interactions. Since 2005, CSCL has changed from a distinct pedagogical approach to an integrated part of comprehensive environments (Dillenbourg, Järvelä & Fischer, 2009).

Collaborative learning is more effective with the right group size, the right individual knowledge level, and the suitable nature of the task (Dillenbourg, 1999). Most research has attempted to measure the effects of collaborative learning. As Dillenbourg suggested it's meaningless if the effects were defined from a broad way which included variety of contexts and interactions. It's, thus, better to specify the effects from specific situations (Dillenbourg, 1999). Prior research has shown that collaborative learning can enhance critical thinking (Gokhale, 1995). It's was found from the study of Gokhale (1995) that students who participated in collaborative learning had performed significantly better on critical thinking test than students who studied individually. Collaborative learning medium helped students to learn from each other's skills, experiences through analyzing, synthesizing, and evaluating ideas cooperatively (Gokhale, 1995). Collaborative learning group work could also improve classroom relations. And better work relations can improve group skills (Tolmie et al., 2010).

However, there can be a lot of different types of challenges in collaborative learning, which affect the effectiveness of collaborative learning. Except cognitive challenges and motiva-

tional challenges, there are also socio-emotional challenges (Näykki, Järvelä, Kirschner, & Järvenoja, 2014). A research has found that motivation and emotions play a central role in collaborative learning (Thompson & Fine, 1999). Positive emotions can initiate upward spirals toward increasing emotional well-being by broadening the scopes of attention and cognition (Fredrickson & Joiner 2002). Through the research of Pekrun in control-value theory of achievement emotions, it was found that achievement emotions not only affect cognitive processes, motivational processes, and regulatory processes, but also affect psychological well-being, happiness, and general life satisfaction (Pekrun 2006).

### 3. EMOTION EXPRESSIONS IN COLLABORATIVE LEARNING

There are a wide variety of definitions of emotion, for example Kleinginna and Kleinginna (1981) have compiled and classified a large amount of literature resources of emotion definitions into an outline of 11 categories. These 11 categories of emotion definitions are affective definitions (emphasizing feelings), cognitive definitions (emphasizing appraisal or labeling processes), external stimuli definitions (emphasizing external emotion-generating stimuli), psychological definitions (emphasizing internal physical mechanisms of emotion), emotional/expressive behavior definitions (emphasizing externally observable emotional response), disruptive definitions (emphasizing disorganizing or dysfunctional effects of emotion), adaptive definitions (emphasizing organizing or functional effects of emotion), multi aspect definitions, (emphasizing several interrelated components of emotion), restrictive definitions (emphasizing distinguishing emotion from other psychological processes), motivational definitions (emphasizing the relationship between emotion and motivation), skeptical statements (questioning the usefulness of the concept of emotion). In general, emotions have a lot of characteristics, including affective, cognitive, physiological, motivational, expressive, disruptive, and adaptive components (Kleinginna & Kleinginna 1981).

Pekrun has used the concept of academic emotions to study emotions in education field (Pekrun, Goetz, Titz & Perry, 2002). Academic emotions refer to emotions which students experience during academic settings; in classroom-, test- or exam situations. Students can experience a variety of emotions in academic settings, including process emotions (such as enjoyment and boredom), prospective emotions (such as anticipatory joy, hope, hopelessness, anxiety), retrospective emotions (joy about success, satisfaction and pride, relief, sadness, disappointment, shame, and guilt), and social emotions (gratitude, empathy, admiration, sympathy, love, anger, jealousy and envy, contempt, antipathy and hate) (Pekrun et al., 2002). Academic emotions include achievement emotions that are emotions tied directly to achievement activities or achievement outcomes (Pekrun, 2006). There are two different types of achievement emotions, which are activity related emotions and outcome emotions. Outcome emotions include prospective emotions and retrospective emotions (Pekrun, 2006). Pekrun (2002) assumed that emotions can have positive and negative characteristics and the activation of emotions was a second traditional dimension to define emotions. Pekrun with colleagues (2002)

defined positive activating emotions (such as enjoyment of learning, hope for success, or pride); positive deactivating emotions (e.g., relief, relaxation after success, contentment); negative activating emotions (such as anger, anxiety, and shame); and negative deactivating emotions (e.g., boredom, hopelessness).

The prior research has shown that the frequencies of different emotions which students experience in academic settings are different depending on the type of academic situation (Pekrun et al., 2002). In the situations of learning in class, or studying at home, or taking exams, students mentioned to experience most often of anxiety. Pressure and expectancies of failure were major contributors. Except negative emotions, positive emotions, such as enjoyment, hope, pride, and relief, appeared also very often in academic settings (Pekrun et al., 2002). There were also some emotions which were reported less frequently, such as gratitude, admiration, contempt, envy, and hopelessness (Pekrun et al. 2002).

Since 1970s, research on emotions has seen the dramatic increase in many different scientific disciplines, such as the neurosciences, economics, anthropology, and the humanities (Pekrun & Linnenbrink, 2014). In contrary, the studies on emotions in education field have emerged slowly (Pekrun & Linnenbrink, 2014). However, the research on students' and teachers' emotions has increased steadily (Pekrun & Linnenbrink, 2014). The studies of emotions in collaborative learning have also got some researchers' attention. In 2005, Järvenoja and Järvelä did a research on students' description of their emotional and motivational experience in collaborative learning process. Students' descriptions of their emotions had several sources and the sources had been created to five different categories. The five different categories of the sources of emotional experiences were self, task, performance, context and social. The study also demonstrated the ways that students expressed and controlled their emotions (Järvenoja & Järvelä, 2005). Järvenoja and Järvelä (2009) did another research in collaborative learning groups through students' interpretations of experienced social challenges and their attempts to regulate their emotions evoked by these challenges. And the results showed that students experienced a lot of emotions due to the challenges of teamwork, collaboration, external constraints, and they also could self-regulate or shared regulate of these emotions (Järvenoja & Järvelä, 2009). Fabria and his colleagues (2004) designed an avatar head model with six human-like universal emotions (surprise, anger, fear, happiness, disgust/contempt, and sadness) to investigate the efficacy of the model. Although the virtual face representations were not

able to work for all expressions of an emotion category, it can effectively work for a limited number of emotions, such as anger and sadness (Fabri, Moore & Hobbs 2004). Näykki with her colleagues (2014) found that in collaborative learning groups, socio-emotional conflicts can happen due to overruling, status centric, undermining and normative interaction. Furthermore, they explored the students' reactions after the socio-emotional conflicts and indicated that some of the students chose avoidance-focused emotion regulation and lowered their task engagement (Näykki et al., 2014). Capdeferro and Romero (2012) used online collaborative learning experience to investigate whether online collaborative learning participants experienced frustration or not and to identify the sources to which the learners attributed their frustrations. And the results showed that students experienced frustration in online collaborative learning. The most important source of frustration was the perception of an asymmetric collaboration among teammates. There were also other sources which would cause frustration, such as identified difficulties related to group organization, the lack of shared goals among the team members, the imbalance in the level of commitment and quality of the individual contributions, the excess time spent on the online CSCL tasks, the imbalance between the individual and collective grades, and difficulties in communication. Kreijns and colleagues (2003) explored computer-supported collaborative learning and showed that students in collaboration tended to focus on cognitive processes rather than social emotional processes (Kreijns, Kirschner, & Jochems, 2003).

### **3.1 Positive emotions in collaborative learning**

Positive emotions include happiness, joy, contentment, gratitude, interest, love and hope, amusement, serenity, enjoyment, satisfaction, pride, relief, empathy, admiration, and sympathy (Fredrickson 2003; Pekrun et al., 2002). Positive emotions have received very little research attention in the past, maybe because positive emotions were hard to study (Fredrickson, 2003).

Positive emotions are essential for human behavior and adaptation (Fredrickson, 2003). Fredrickson (2003) has proposed the broaden-and-build theory, which explains the value of positive emotions to broaden momentarily an individual's attention and thinking and prepare an individual with a broader thought-action repertoire for later hard times. Later, when people meet the problems in life, this repertoire will give people more energy to deal with them.

These positive emotions will have deep and enduring effects (Fredrickson, 2003). Positive emotions can make people more creative, integrative, flexible, and open, which lead to the development of intellectual resources, physical resources, social resources, and psychological resources in the future (Fredrickson, 2003). Positive emotions can, for example, help people to open their mind to solve problems and achieve their goals by coping with challenges (Fredrickson, 2003). Positive emotions can also undo the lingering effects of negative emotions and help people to recover sooner from the negative emotions repercussion (Fredrickson, 2003). It is reported that people who express more positive emotions will live longer than those who express the fewest (Fredrickson, 2003). In general, positive emotions reduce the physiologic damage to make people feel good (Fredrickson, 2003).

Positive emotions are also vital in group interaction since they help groups to sustain their positive group interactions (Linnenbrink-Garcia et al., 2011). Neutral to deactivated positive affect, such as happy or calm had significant relations with positive group interactions (Linnenbrink-Garcia et al., 2011). Students who felt calm reported more positive group interactions (Linnenbrink-Garcia et al., 2011). Activated positive affect (excitement) was not significantly related to lower social loafing. Feeling happier than sad associated higher positive group interactions. Similarly, feeling more excited than tired also connected with higher positive group interactions. (Linnenbrink-Garcia et al., 2011). Positive group interactions can initiate more positive affect than negative affect. For example, students felt happier than sad or more excited than tired performed better in group work. (Linnenbrink-Garcia et al., 2011). However, positive emotions can also cause students to do social loafing and to also engage in off-task behaviors. For example, joking with each other and laughing about topics unrelated to the task can cause social loafing. But feeling tenser than calm related more positively to social loafing (Linnenbrink-Garcia et al., 2011).

Based on Fredrickson's experiment (2003) with college students, it was suggested that indirect ways to cultivate positive emotions by finding positive meaning were much better than indirect attempts to stimulate positive emotions (such as humor, laughter and so on). Positive meaning can be obtained from giving ordinary events meaningful and solving problem effectively (Fredrickson, 2003). According to research about positive emotions, people tend to prolong or maintain the states of their positive emotional experiences (Tugade & Fredrickson, 2007). People can prolong their positive emotion experiences by communicating with others



or celebrating with others (Langston, 1994). People can enhance or increase their positive emotions by thinking or creating positive meaning in ordinary events when they meet negative situations (Tugade & Fredrickson, 2007). Situational interest and topic interest were related with students' perception of social relatedness, autonomy, and competence (Boekaerts & Minnaert, 2006). In this study (Boekaerts & Minnaert, 2006) social relatedness referred to enjoyment of group work and team spirit in their small group. The study examined students' satisfaction of the need for autonomy and the need for social relatedness.

### **3.2 Negative emotions in collaborative learning**

Negative emotions include anger, anxiety, sadness, fear, disgust, boredom, hopelessness, disappointment, shame and guilt, jealousy and envy, contempt, antipathy and hate (Fredrickson, 2003; Pekrun et al., 2002). Negative emotions are obvious and specific with relation to survive (Fredrickson, 2003) and it is thus easier to detect negative emotions than positive emotions from facial expressions (Fredrickson, 2003). Negative affect can cause the tendency to social loafing, such as activated negative affect (tense) and deactivated negative affect (tired) (Linnenbrink-Garcia et al., 2011). Both deactivated and activated negative emotions can cause lower engagement, which refers to social loafing and lower quality of social interactions (Linnenbrink-Garcia et al., 2011). However, except the deactivated effect of negative emotions, activated negative emotions such as anger may also help individuals to find ways to cope with their anxiety (Pekrun et al., 2002).

Prior studies indicate that negative group interactions can provoke negative emotions (upset, frustration, sadness) (Linnenbrink-Garcia et al., 2011). However, negative emotions (frustration, sadness, upset) have also the potential to evoke positive group interactions. For example, if a student experiences frustration, his/her group members can try to help him/her to deal with it (Linnenbrink-Garcia et al., 2011).

Negative emotions have been researched by several studies in the learning context of collaborative learning (i.e. Zschocke, Wosnitza & Bürger, 2016; Järvenoja & Järvelä, 2005; Volet & Mansfield, 2006; Eteläpelto & Lahti, 2008). Zschocke, Wosnitza and Bürger (2016) studied emotions in groups from an appraisal-oriented perspective to explore the relationship of students' appraisal and emotion during group work. Their study (Zschocke et al., 2016) disentangled the relationship between individual differences in group work appraisals and emotions

that aroused in the context of a real-life group assignment. The results showed that students' appraisals changed in management, group assessment and interpersonal dimensions predicted deactivated negative emotions. However, the changes of students' appraisals did not explain activated negative emotions. Students' emotion orientation was also predicted by the types of group working, which referred to work collaboratively or cooperatively. Working collaboratively showed slightly lower deactivated negative emotions than working cooperatively. The activated negative emotions and the types of group working were not significantly related (Zschocke, Wosnitza, & Bürger, 2016). Järvenoja & Järvelä (2005) had investigated how negative emotions affected learning process. There was an example. During the first part of the study, one group member was frustrated and annoyed and he tried to concentrate on the project, however, he couldn't focus on the task. And he showed his frustration by shaking his head and talking to himself or to his friends. As examined by Volet and Mansfield (2006), students' negative appraisals can cause extreme frustration regarding group assessment. This kind of frustration can make the whole group atmosphere negative (Eteläpelto & Lahti, 2008). The main obstacles in a group level to creative collaboration were related to the emotional atmosphere and power relations of the group. In the weakest collaborative learning situations, the emotion atmosphere was described as negative atmosphere. In the negative atmosphere, students felt unsafe, insecure, oppressive, rigid, and intolerant (Eteläpelto & Lahti, 2008).

In brief, emotions in collaboration learning are very important and have been investigated from some perspectives. However, the emotional types in collaborative learning itself are under-researched. Hence, this study aimed to explore the types of emotions in collaborative learning and how students express their emotions.

#### **4. AIM AND RESEARCH QUESTIONS**

The aim of the study was to find different types of emotion expressions in collaborative learning and the ways (verbal and nonverbal) that students expressed their emotions in collaborative learning.

Specific research questions in this study were: (1) What kind of positive and negative emotions students expressed during collaborative learning? (2) What were the main types of emotion expressions in collaborative learning groups? (3) Were the types of emotion expressions different in two different groups? (4) Were the types of emotion expressions different in different sessions? (5) How students expressed different types of emotions during their collaborative learning? a. What emotions were expressed with verbal expression more often? b. What emotions were expressed with non-verbal communication more often?

## 5. METHODS

### 5.1 Participants and procedure

The participants were the first-year teacher education students from Oulu University in 2015. These participants were one part of the project of preparing pre-service students for 21<sup>st</sup> century learning practices (PREP21—N = 96, 74 females, 22 males, mean age is 23), which was a project to understand productive and strategic collaborative interactions, to understand how was the process of collaborative interaction with macro-and micro-level analysis orientations, and particularly, to enhance their collaborative learning skills (Näykki, Pöysä-Tarhonen, Järvelä, & Häkkinen, 2015; Näykki, Isohätälä, Järvelä, Pöysä-Tarhonen, & Häkkinen, 2017). The research design of the PREP21 project included the idea of macro-scripting. The main idea of macro-scripting was to support collaborative learning with orientation, check-up, and reflection script questions that instructed students to discuss their group's goals and needed strategies, to monitor their progress and performance (Näykki, Pöysä-Tarhonen, Järvelä, & Häkkinen, 2015; Näykki, Isohätälä, Järvelä, Pöysä-Tarhonen, & Häkkinen, 2017). The participants worked in groups. There were cameras when the participants were working. The cameras recorded every session. Each group had 3 to 4 members. There were 24 groups all together. The groups were equally divided according to students' self-evaluated collaborative learning skills. During 8 working courses there were 6 face-to-face working sessions. In each session, the groups had a different task to deal with. PREP21 project had recorded all the sessions both in Natural Science Course and Mathematics Didactics Course.

### 5.2 Data collection

The data was collected in the form of video observation from mathematic didactic course. And the course took place in a classroom-like research space with 360 degree cameras and individual microphones for each participant. Video recording is becoming more popular in research, because videos can document naturally occurring interactions and can preserve relevant details in specific contexts. Also, video recordings can be edited through different ways, for example, compression, cutting, reassembling, clips editing which offer researchers a lot of ways to analyze video data (Mondada, 2006).

This study had chosen 2 groups who attended mathematics didactics course to collect data. These two groups were videotaped while working in the collaborative learning groups. The two groups were group3 and group4. In group3, their members were Anni, Kevin, Katija and Hanna. In group4, their members were Taija, Paula, Anne, and Eeva. The names were changed to secure students' privacy. There were 6 sessions in total. In each session, they had a different math task to solve.

At the beginning of the session each student introduced their name and date first. Then they read instructions about their task and discussed about the instructions. After that, they would use macro-scripts to do group evaluation. The following step was to work on their task collaboratively. At the end of each session, the teacher reminded each group to do post-task group evaluation. Then the session was over.

The groups' verbal and nonverbal expressions were recorded with good cameras and microphones (every student had a microphone). Each session had a video, which was about 1 hour long. Altogether, there were 6 videos for each group and 11 videos for 2 groups.

### **5.3 Data analysis**

This study used Nvivo software to analyze video data to find the types of students' emotion expressions in collaborative learning. Nvivo can support researchers to do qualitative data analysis more easily and efficiently. Nvivo can manage data, manage ideas, query data, visualize data, and report from the data. NVivo continues to be developed by researchers and gets feedback from the users which guarantee a more powerful data software (Bazeley & Jackson 2013).

This study analyzed data in two rounds. The first round was to find emotion expression examples in collaborative learning from the videos according to the coding categories. The second round was to find how students in groups expressed their emotions, which focused on whether the students expressed their emotions with verbal communication or nonverbal communication. There was one thing should be mentioned that during the two-round analysis, this study didn't use the video of group3, session2. The two members discussed their tasks in Finnish, so this session wasn't analyzed.

In the first-round analysis, at first the researcher watched all the videos and read the task instructions to get a general understanding of all the learning situations and the content of the videos. Second, the researcher transcribed the videos with emotion expression part into texts in Nvivo software. Third, the main coding categories and the sub-categories were formulated. Fourth, the researcher used Nvivo software to code all the emotions according to the coding categories. The main coding categories were negative emotions and positive emotions. In negative emotions, there were 12 sub-categories, which were boredom, tiredness, confusion, upset, anxiety, disappointment, exhaustion, depression, worry, abandonment, frustration, and petrification. In positive emotions, there were 9 emotions, which were calmness, happiness, relaxation, interest, excitement, enthusiasm, anticipation, determination, and optimism. Table 1 shows the coding categories and subcategories. All the types of emotion expressions that had been found in these collaborative learning videos and data examples were also presented in the Table 1. (All the descriptions of the emotion types were cited from the online Cambridge dictionary: <http://dictionary.cambridge.org/>).

*Table 1 Coding rules and examples of the analysis of emotion expressions*

Coding category	Sub-category	description	Data examples
Negative emotions	Boredom	A state of feeling unhappy because something is not interesting or because you have nothing to do.	Anni says she was more excited last time and now she feels the task is boring.
	Tiredness	In need for a rest or sleep or something is not interesting.	Anni and Katija laugh. Anni laughs and says, "I'm so done, I am just tired, oh it's not my day" and then Katija and Anni discuss gym.
	Confusion	A situation in which people don't understand what	When Hanna explains something, then Katija says you confuse me. Hanna says "Yee, I confuse also

	is happening and what should they do.	myself.” Kevin says this is really confusing.
Upset	Worried, unhappy, or angry.	At the end of the discussing, Anni says: "Ah, this is annoying me." When she says this, she puts her head down and holds her head with her hands.
Anxiety	An uncomfortable feeling of nervousness or worry about something that is happening or might happen in the future.	Anne says: "It doesn't pop out at all, keyboard. “Then Taija helps. Anne expresses her unhappiness: "This is so nap. “Anne says: "I don't know how to use this crap."
Disappointment	The feeling of being disappointed. Disappointed refers to unhappy because someone or something was not as good as you hoped or expected or because something didn't happen.	Katija says " But as a university student, this is not challenging. I just feel like (she makes a speechless gesture with her two hands.)"
Exhaustion	The state of being extremely tired.	Kevin says: "My head is like...r..." He puts his two hands squeezing his head and makes a painful expression.
Depression	The state of feeling very unhappy	Anne tries to do the exercise but at last she quits: "Someone else please do this, it drives me crazy. "She makes her scarf looser to release her stress.

Worry	A feeling of being unhappy and frightened about something.	But Hanna is also worried, because this instruction seems really long. There is a lot texts and then the questions are just...
Abandonment	The state to leave a place, thing, or person, usually forever	Katija looks around and says: "Where is the teacher?" Kevin says: "I don't know." Katija: "To be honest, where is everybody? I feel like they just abandoned us in this windowless self-educating room. "Kevin says: "Nobody cares."
Frustration	The feeling of being annoyed or less confident because you can't achieve what you want, or something that makes you feel like this.	What kind of feelings does your work arouse? Paula says: "Frustration at this." Then Taija says: "something about waiting and frustration. "Especially when you are tired and have stuff to do."
Petrification	The feeling of being frightened a lot, especially so that you are unable to move or speak.	They are doing the group evaluation. Katija asks "what kind of feelings does the task arouse? Katija: I feel like it's petrified. Because the texts and the questions are too long and too complicated. She can't just simply answer them.

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Positive emotions	Calmness	The feeling of peaceful, quiet, and without worry.	Katija suggests they should write down the ideas when they are reading. They are discussing calmly.
	Happiness	The feeling of pleasure or satisfaction.	They are doing the questions one by one. During their learning, Anne laughs: "It's like French fries." It makes everyone bursts into laughs. Paula says: "Help you learn."
	Relaxation	The feeling of being happy and comfortable because nothing is worrying you.	Looking at other group, Kevin and Katija laugh and Katija makes a joke: "We don't even see what you guys talk." Katija says: "This is how our team works. We just copy".
	Interest	The feeling of wanting to give your attention to something or of wanting to be involved with and to discover more about something.	They are using the 10 blocks. Anne thinks base ten blocks are cool and can be counted. Eeva thinks this would help her a lot because she is a visual learner.
	Excitement	A feeling of very happy and enthusiastic.	Hanna is laughing. And Katija has smile in her face. Katija mentioned their last experience enthusiasm with smiling on her face. And Hanna say "ye, ye" with smile on her face.

Enthusiasm	A feeling of energetic interest in a special subject or activity and an eagerness to be involved in it.	Hanna and Kevin are making shapes as the task asks. When Hanna finishes one, she says: "Look! Wow, I made an awesome. Now it's a skinny one." And then she giggles. Katija says: "Hanna, you look like you have so much fun."
Anticipation	A feeling of excitement about something that is going to happen soon.	They are discussing their work progress. They agree that they have learned the theory, but they haven't done the exercise. What's your feelings? Anne thinks it's cool and she wants to play more. When she said that she was using a happy voice.
Determination	The ability of continuing to try to do something, although it is very difficult.	After comparing with others, Hanna says with a smile: "Oh, I have done it wrong again, I have done it wrong twice. "Although she says' 'I don't want to", but she does it again.
Optimism	The quality of being full of hope and emphasizing the good parts of a situation, or a belief that something good will happen.	Hanna: All of us are positive, optimistic and have group dynamic.

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In the second-round analysis, the emotion expressions - both positive emotions and negative emotions which had been found in the first round of the analysis had been coded by verbal expression and nonverbal expression in Nvivo software. During this round of the analysis, this study attempted to find the ways that students were using for expressing their emotions in collaborative learning groups. Table 2 gives examples and descriptions of what verbal expression and nonverbal expression mean. And second round data analysis was based on the coding categories of verbal expression and nonverbal expression.

*Table 2. Coding categories and examples of the ways to express emotions*

Coding category	Descriptions	Data examples
Verbal expression	The students express their emotions verbally (Berry & Pennebaker 1993).	The group is discussing the question what kind of the feelings does the task arouse. Hanna says she is excited. She seems to be now more excited than she was during the previous task. Anni says she was more excited last time because it's colorful or either both are boring. she feels it's boring. She thinks maybe she is tired.
Nonverbal expression	The students express their emotions in facial display, body movement, gesture, and nonverbal utterances such as screams and cries (Berry & Pennebaker 1993).	Anni is just sitting there quietly and looking at others with her hands under the table and doing nothing.

## 6. RESULTS

The aim of the study was to find different types of emotion expressions in collaborative learning and how students expressed their emotions during collaborative learning. The results are presented in five aspects: (1) The types of emotion expressions in collaborative learning groups. (2) The main types of emotion expressions in collaborative learning groups. (3) How did the types of emotion expressions vary in different groups? (4) How did the types of emotions vary in different sessions? (5) The ways that students expressed their emotions in collaborative learning: a. The emotions which were expressed more often with verbal expression; b. The emotions which were expressed more often with nonverbal expressions.

### 6.1 The types of emotion expressions in collaborative learning groups

The results of the analysis indicated the types of emotion expressions in collaborative learning groups.

According to Table 3, 21 different types of emotion expressions were observed during the collaborative learning of this study. There were both negative emotion expressions and positive emotion expressions during collaborative working. These 12 negative emotion expressions were found after the analysis, which were boredom, tiredness, confusion, upset, anxiety, disappointment, exhaustion, depression, worry, abandonment, frustration, and petrification. These 9 positive emotion expressions were also found after data analysis, which were calmness, happiness, relaxation, interest, excitement, enthusiasm, anticipation, determination, and optimism (See Table 3).

The types of negative emotion expressions were a little bit more than the types of positive emotion expressions, which were observed in this study. Some emotions were not observed through this study, such as anger, shame, hopelessness.

Table 3. The number of observed emotional expression types

Negative emotions	<i>f</i>	Positive emotions	<i>f</i>
Boredom	34	Calmness	45
Tiredness	26	Happiness	39
Confusion	19	Relaxation	32
Upset	10	Interest	20
Anxiety	9	Excitement	20
Disappointment	6	Enthusiasm	12
Exhaustion	4	Anticipation	6
Depression	4	Determination	6
Worry	3	Optimism	4
Abandonment	2		
Frustration	2		
Petrification	2		

\**f* means the frequency of the emotion expressions.

## 6.2 The main types of emotion expressions in collaborative learning groups

The Table 3 showed the main types of emotion expressions in collaborative learning groups. Boredom ( $f = 34$ ) appeared the most in negative emotion expressions in collaborative learning groups while tiredness ( $f = 26$ ) was the second most occurring negative emotion. The frequency of confusion ( $f = 19$ ) was slightly smaller than tiredness. Upset ( $f = 10$ ) and anxiety

( $f=9$ ) followed the confusion which gave them the fourth and fifth place respectively in emerging negative emotions. The appearance of other negative emotions was significantly smaller than boredom, tiredness, and confusion, upset and anxiety. According to the descriptions above, the main types of negative emotion expressions in collaborative learning of this study were boredom, tiredness, confusion, upset and anxiety.

In positive emotions expressions, from Table 3 we can see clearly that calmness ( $f=45$ ) was the number one emotion expression. Happiness stayed in number two with the frequency of 39. After that, there was relaxation ( $f=32$ ) which become the third most often appearing positive emotion expressions in collaborative learning groups. Interest ( $f=20$ ) and excitement ( $f=20$ ) stood side by side to become the fourth positive emotion expressions. The frequency of the following positive emotion expressions below excitement dropped quickly from 12 to 4. Therefore, the Table 3 led to the conclusion that calmness, happiness, relaxation, interest, and excitement were the main types of positive emotion expressions in this study.

It's easy to find from Table 3 what was the main types of emotion expression in collaborative learning groups comparing the negative emotion expressions and positive emotion expressions together. The positive emotion expression calmness ( $f=45$ ) was the most often emerging emotions in collaborative learning groups. And then the emotion expressions which appeared more than 19 times were happiness, boredom, relaxation, tiredness, interest, excitement, and confusion. To sum up, according to the order from more to less, the main types of emotion expressions in collaborative learning of this study were calmness, happiness, boredom, relaxation, tiredness, interest, excitement, and confusion. In one word, there were 8 types of main emotion expressions in collaborative learning groups and the first two emotion expressions were positive emotion expressions, which meant normally the positive emotions were the main types in collaborative learning of this study. However, the other two negative emotion expressions (boredom, tiredness) also appeared a lot of times.

### **6.3 The types of emotion expressions varied in two different groups.**

The types of emotion expressions varied in different groups. According to Table 4, the frequencies of observed emotion expressions were different in group3 and group4. In negative emotion expressions, some of the emotion expressions appeared more in one group and some

of the emotion expressions were only observed in another group. Besides, some emotion expressions had the same number in both groups. As you can see, the number of boredom in group3 ( $f=22$ ) was much bigger than that of in group 4 ( $f=12$ ). In group3, tiredness, upset, and depression were slightly more than group4. The emotion expressions of worry, abandonment and petrification were only found in group3. There was more confusion in group4 ( $f=12$ ) than in group3 ( $f=7$ ). Furthermore, anxiety in group4 ( $f=6$ ) was twice the number of in group3 ( $f=3$ ). In addition, the emotion expression of frustration was only found in group4. The frequency of disappointment and exhaustion was the same in both groups. In short, group3 went through more negative emotions of boredom, tiredness, upset, depression, worry and abandonment while group4 went through more negative emotions of confusion, anxiety, and frustration.

However, the emotion expression situations in positive emotion expressions were different than that of in negative emotion expressions. As is reflected in Table4, calmness, happiness, and relaxation in group4 were obviously more than that of in group3. The number of Calmness, happiness, and relaxation in group4 were 24, 24, 17 respectively comparing to 21, 15, 15 respectively in group3. However, anticipation was 5 times in group3 than that of in group4 while enthusiasm and optimism were 3 times than that of in group4. In both group3 and group4, the number of determination was the same ( $f=3$ ). In brief, group4 experienced more positive emotions of calmness, happiness, and relaxation while group3 experienced more positive emotions of anticipation, enthusiasm, and optimism.

*Table 4. The number of observed emotion expressions in two different groups*

		Group 3	Group 4	Total
		$f$	$f$	$f$
Negative emotions	Boredom	22	12	34
	Tiredness	14	12	26
	Confusion	7	12	19
	Upset	6	4	10
	Anxiety	3	6	9

	Disappointment	3	3	6
	Exhaustion	2	2	4
	Depression	3	1	4
	Worry	3	0	3
	Abandonment	2	0	2
	Frustration	0	2	2
	Petrification	2	0	2
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Positive emotions	Calmness	21	24	45
	happiness	15	24	39
	Relaxation	15	17	32
	Interest	12	8	20
	Excitement	11	9	20
	Enthusiasm	9	3	12
	Anticipation	5	1	6
	Determination	3	3	6
	Optimism	3	1	4
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#### 6.4 The types of emotion expressions varied in different sessions

This study used the videos of group3 and group4 as data to analyze. Each group joined six sessions, so basically there were 12 videos. But as this study mentioned in data analysis part, session2 of group3 was not analyzed, so there were only 11 videos being analyzed. Therefore, that's why the figures in session2 of group3 were appeared in 0 all the time.

Table 5 showed us that the emotion expressions were different in each session of each group. From the horizontal comparison, we can see that boredom appeared the most in session3, group3( $f=11$ ). When analyzed the video data session3, group3, this study found that one of the group members Anni from group3 brought a lot of negative emotions which apparently affected everyone's motivation in this session. This is one transcribed paragraph from the video "Anni is yawning and then she sits there looking at somewhere and tries to drink waters to transfer her attention. The others are working collaboratively and independently. Hanna asks a lot of questions. Anni says 'I understood, I'm just too lazy to draw.' After that she is just sitting there quietly and doing nothing." The negative emotion atmosphere can be spread to every group member easily. That was why the whole group in session3 seemed very negative in their learning tasks. The second session which also had a lot of boredom experience was session5 of group4( $f=7$ ). There is one example from the transcribed text, which can explain why there were a lot of boring experience in session5 of group4. "They are giving grades to the task. Paula says: 'I have no battery'. It doesn't matter. Then Eeva asks what the time is it. Paula told her. And Eeva says unhappily: 'what! I thought it's going to be 4.' And then she says 'I thought this was going to be the most exciting thing we have ever done in our lives. In contrary, this is the most boring thing we have ever done in life.'"

Tiredness had been found the most in session4 of group4. The main reason was that the tasks were not interesting enough. Evidence is found from the transcribed text "The teacher asks them to do the check-up. The second question is what kind of feelings does your work arouse? Eeva answers: 'There are still a lot of interested forms.' Then everyone laughs. Taija thinks that she is getting bored. The third question is what kind of challenges are you currently facing? Paula answers: 'Tiredness.' When she speaks, she is wiping her eyes with her hands. The others agree with her. The last question is how you proceed from here on? Eeva answers: 'Like always.' Then everyone laughs."



Positive emotions	Calmness	3	5	0	3	2	2	8	6	5	4	3	4
	Happiness	8	8	0	9	3	0	1	6	3	1	0	0
	Relaxation	1	1	0	1	1	3	5	5	5	4	3	3
	Interest	6	3	0	3	1	0	0	0	4	1	1	1
	Excitement	5	2	0	0	3	5	1	1	2	0	0	1
	Enthusiasm	4	0	0	2	1	0	0	0	3	0	1	1
	Anticipation	3	2	0	1	0	0	0	0	0	0	0	0
	Determination	2	0	0	0	2	0	1	0	0	0	0	1
	Optimism	1	1	0	0	1	0	0	0	1	0	0	0

(\*G3 means Group 3, G4 means Group 4)

### 6.5 The ways that students expressed different types of emotions during their collaborative learning

There are different ways for students to express their emotions in collaborative learning. This study focused on expressing emotions verbally and nonverbally. The verbal way to express emotions refers to the way to express one's emotions by speaking them clearly with language. The way to express emotion nonverbally emphasizes it as mental abilities (Salovey & Mayer 1990).

a. What types of emotions were expressed with verbal expression more often?

The Table 6 depicted that confusion, upset, disappointment, worry, frustration and petrification were expressed more often in verbal expression than in nonverbal expression in negative emotions while in positive emotions, relaxation, interest, and optimism were expressed more often in verbal expression than in nonverbal expression. In Table 6, we can see that the most often observed emotion verbally was confusion. The ratio between verbal communication and nonverbal communication is 18:1.

b. What types of emotions were expressed with non-verbal expression more often?

Based on the Table 6, in negative emotion expressions, boredom, tiredness, anxiety, and exhaustion were expressed more often in nonverbal expressions than in verbal expression. In positive emotion expressions, calmness, happiness, enthusiasm, anticipation, and determination were expressed more often in nonverbal expressions than in verbal expressions. In Table 6, we can see that the most often observed emotion nonverbally was calmness. The ratio between nonverbal communication and verbal communication is 45:0.

*Table 6. Emotion expressions with verbal communication or nonverbal communication.*

	Emotion expressions	Verbal <i>f</i>	Nonverbal <i>f</i>	Total <i>f</i>
Negative emotions	Boredom	11	23	34
	Tiredness	6	20	26
	Confusion	18	1	19
	Upset	9	1	10
	Anxiety	4	5	9
	Disappointment	6	0	6
	Exhaustion	1	3	4
	Depression	2	2	4
	Worry	3	0	3
	Abandonment	1	1	2
	Frustration	2	0	2
	Petrification	2	0	2

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Positive emotions	Calmness	0	45	45
	Happiness	12	27	39
	Relaxation	20	12	32
	Interest	15	5	20
	Excitement	10	10	20
	Enthusiasm	0	12	12
	Anticipation	0	6	6
	Determination	1	5	6
	Optimism	4	0	4

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There were some examples from the data to show students' verbal emotion expressions and nonverbal emotion expressions. The emotion of confusion was normally expressed verbally. For example, "when they are using the instruction paper to build blocks. Anni says: 'It just so confusing that the front is kind of the first one here, so I just started to look at that.' Katija also agrees with her. At the same time, Kevin is using blocks to build something. And then Hanna says: 'I don't know what you are getting out of these pictures. For me I don't understand. Is this sort of, so this means it's nothing?'" From this example, we can see that verbal emotion expressions can be recognized from the words. The following example was the emotion of boredom which was nonverbally expressed. "Anni is yawning and then she sits there looking at somewhere and tries to drink waters to transfer her attention. The others are working collaboratively and independently." From this example, we can see that boredom was expressed with facial expressions and body gestures.

## 7. DISCUSSION

The present study explored the types of emotion expressions in collaborative learning contexts and the ways that students expressed their emotions (non-verbal and verbal). The findings particularly revealed the main types of emotion expressions in collaborative learning groups. The main types of emotion expressions in collaborative learning of this study were calmness, happiness, boredom, relaxation, tiredness, interest, excitement, and confusion. This result was different with Pekrun's (2002) research about the main types of experienced emotions. In his research, anxiety was found the most often reported emotion. However, in this study, calmness was the most often observed emotion. This may be because the research context was different. Pekrun (2002) conducted his research in the situation of taking test and exams which may cause anxiety while the present study did the research in the collaborative learning groups which made calmness the most often appeared emotion. The main types of negative emotion expressions in collaborative learning groups were boredom, tiredness, confusion, upset and anxiety. Boredom and tiredness are negative deactivating emotions (Feldman Barrett, & Russell, 1998). This gives us a hint that when designing a collaborative learning course, the teacher should make the task more challenging and interesting. The results also indicated what emotions were expressed mostly in verbal communication and what emotions were expressed mostly in non-verbal communication. Confusion was expressed most often by verbal communication while calmness was expressed most often by nonverbal communication. This maybe because students would like to express their confusion by words to ask help from the other group members or from teachers. And normally, students didn't express their calmness by words, like "I am calm." They just showed their calmness by working quietly and collaboratively. This is to say, that emotions in group work have different functions. Some emotions are expressed for making the group members aware of one's negative emotions to make possible to give their support, and thus, those emotions function in an interpersonal level (Järvenoja & Järvelä, 2009). Whereas other types of emotional expressions are more personal and these don't require any actions from the group members, but can afford the increase of the mutual awareness of the socio-emotional climate within the group.

The findings are in accordance with Pekrun's "Academic Emotions in Students' Self-Regulated Learning and Achievement: A Program of Qualitative and Quantitative Research". In his article, he found what emotions do students experience in academic settings when attending a

class, studying, and taking test and exams (Pekrun et al., 2002). His research focused more on general level about emotion experience on academic settings while this study focused more on specific situations about the types of emotion expressions. Moreover, the findings of this thesis correspond with research by Zschocke1 et al. (2016) about emotions in groups. Their research paid more attention on the relationship between individual and group work appraisals and students' emotions. Students' group work appraisals were useful in predicting positive activating and negative deactivating emotions. The appraisal changes in group can predict the negative deactivating emotions while can't serve as predictor of negative activating emotions. The present study concentrated more on emotions types in different group situations and different sessions. Group situations were different in emotion expressions in the present study. This thesis also showed how negative emotions can affect the learning atmosphere of the whole group. During the analysis, the present study found that in group3, session3, one of the group member was expressed a large amount of negative emotions, which apparently affected the whole atmosphere of the group learning. Generally, these findings seem to confirm that emotion regulation was needed in collaborative learning when students experience a lot of negative emotions evoked by social challenges (Järvenoja & Järvelä, 2009). In the present study, it was found that the students experienced both negative emotions and positive emotions and altogether 21 different types of emotion expression were found in the collaborative learning process. Besides, affect and students' engagement in small group instruction also give a hint on how emotions affect the group interactions (Linnenbrink-Garcia et al., 2011). In the present study, it has been proved that positive emotions such as happiness, calmness, interest, and excitement can improve the engagement of students. For example, there is a paragraph from the analysis of the video data, from which we can get an example of how positive emotions can improve the engagement of students. "Now Eeva is the teacher. Eeva smiles: 'I want this.' And then she takes a thousand. Paula says: 'Aha!' while making a surprise face. Then she laughs: 'ha-ha.' Eeva smiles: 'Your face looks like, oh my god.' After they put these blocks and then Paula has a question that how to make these blocks tidy in the classroom. Then Anne gives some idea on how to do it. Anne says a number and then Eeva says: 'Good job!' Paula says: 'Good job! Very well done!' They are working collaboratively in a very nice atmosphere."

The findings didn't shed light on the reasons that students experience different types of emotions and this is something that future research could elaborate in more details. This can be found some points from the sources of emotional and motivational experience in learning process (Järvenoja & Järvelä, 2009). The students' self-experience, interest, general thoughts about the situations, personal motivational beliefs can arouse different emotions. For example, students who have former experience of collaborative learning can feel more confident while students who don't have former experience can feel more frustrated. Task itself can also cause different feelings. The students' learning performance can also arouse negative emotions and positive emotions. The context can also cause different emotions. The students can experience more frustration when they don't know what to do. Social and interaction culture of the classroom can also yield different feelings (Järvenoja & Järvelä, 2009). Accordingly, Järvenoja & Järvelä (2009) provided strong support on emotion regulation in collaborative learning which the present study didn't research on. Furthermore, these authors (Fabri, Moore, & Hobbs, 2004) argue that mediating emotion expressions in collaborative virtual learning environment is beneficial to communication. Therefore, further studies on emotions of collaborative learning should consider about the types of emotion expressions, especially positive and negative emotion expressions in more details.

Moreover, some limitations of this study should be mentioned. First, this study used only two-group-video data to analyze the types of emotion expressions in collaborative learning group, which makes the generalizability of the results limited. Second, the types of emotions were intertwined with each other sometimes during collaborative learning, so it's hard to separate one emotion from another emotion. As Fredrickson (2003) advocated that it's hard to differentiate some positive emotions. Joy, amusement, and serenity are not easily distinguished from one another. It's hard to tell the difference of some positive emotions from facial expressions, because they all share the similar smile. Positive emotions don't have the unique signal value as the negative emotions have (Fredrickson, 2003). Third, the time was short, so this study didn't test the reliability of the analysis. However, to increase the reliability, the coding categories are explained in detail and empirical examples from the data are provided. The present study will continue to do the reliability to check the measurement error if possible. Because the measurement error will affect statistical analysis and interpretation. By calculating a reliability index can assess the amount of measurement error (Shrout & Fleiss, 1979).



Finally, this study has several implications for researchers to do research on some topics about emotion in collaborative learning. First, how to help students to foster activated positive emotion and how to help students to cope with deactivated negative emotions and deactivated positive emotions. As Linnenbrink-Garcia et al. (2011) claimed that activated positive emotion can promote group interaction. Deactivated negative emotion and deactivated positive emotion can cause social loafing (Linnenbrink-Garcia et al., 2011). Besides, how can researchers measure students' emotion types in collaborative learning? In addition, how do these negative and positive emotions affect the learning process and achievement in collaborative learning context? Moreover, the frequencies of verbal and nonverbal emotion expression can help researchers to recognize of the functions of different emotions in collaborative learning. Furthermore, it can also give hints on computer supported collaborative learning. Future studies can do research on how these negative emotions and positive emotions affect learning in CSCL contexts.

This study also has practical implications for teachers who design face-to-face collaborative learning courses and computer supported collaborative learning courses. The main types of emotion expressions in collaborative learning have the potential to let the teachers know what kinds of emotions will appear more often during collaborative learning. Therefore, teachers can design better emotion instructions before and during online learning process to scaffold the students' group interactions. Students reported group emotion awareness was a very useful functionality, so many members would have the chance to intervene their group interactions when they noticed some negative feelings (Feidakis, Daradoumis, Caballé, & Conesa, 2013). The verbal communication and nonverbal communication that students use to express their emotions may help the teachers to make collaborative learning more effective. For example, confusion was expressed more often with verbal communication from this study, so the teacher can encourage the students to express some of their feelings verbally, then the whole group can collaborate with each other to solve the problems. The nonverbal emotion expressions can be recognized from nonverbal vocalization, body expressions and facial expressions (Sauter, McDonald, Gangi & Messinger, 2014). Hence, teachers can teach students how to recognize nonverbal emotion expressions to make collaborative interactions more successful.

## 8. CONCLUSION

This study contributes to the emotion research in collaborative learning in a more detailed way to get a whole picture of what are the types of emotion expressions in collaborative learning. The aims of the study were to find the types of emotion expressions in collaborative learning and how students expressed their emotions (verbal and nonverbal) in collaborative learning. The results were found from 5 different parts after video data analyzing. (1) The results showed that 21 different types of emotion expressions were observed in collaborative learning which were categorized as negative emotion expressions and positive emotion expressions. (2) The main types of emotion expressions in this study were calmness, happiness, boredom, relaxation, tiredness, interest, excitement, and confusion according to the order from more to less. (3) The main types of emotion expressions varied in different groups. Group3 went through more negative emotions of boredom, tiredness, upset, depression, worry and abandonment and experienced more positive emotions of anticipation, enthusiasm, and optimism. Group4 went through more negative emotions of confusion, anxiety, and frustration and experienced more positive emotions of calmness, happiness, and relaxation. (4) The main types of emotion expressions varied in different sessions. In this part, this study used some data examples to explain the possible reasons why emotional types were different in some sessions. (5) The results also indicated that what emotions were expressed more often in verbal communication and what emotions were expressed more often in non-verbal communication. Confusion, upset, disappointment, worry, frustration and petrification, relaxation, interest, and optimism were expressed more often in verbal expression than in nonverbal expression. Boredom, tiredness, anxiety, and exhaustion, calmness, happiness, enthusiasm, anticipation, and determination were expressed more often in nonverbal expression than in verbal expression. The most often observed emotion verbally was confusion while the most often expressed nonverbally was calmness.

In future studies, one suggested topic is how to help students to foster activated positive emotions in collaborative learning groups. Another interesting topic is the functions of different types of emotions in collaborative learning.

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