The Changes in Lower Secondary School Students’ Interest During Collaborative Learning

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ABSTRACT
This study explored the situational interest and emotional valence of 13-year-old students (N = 94) participating in a five-session science course. The relationship between students’ situational interest and emotional valence and their individual interest was also studied. During each session, students participated in a collaborative learning task. Before and after each task, students’ situational interest and emotional valence were measured through a single-item self-report questionnaire. Individual interest was measured by the Task Interest Inventory scale at the beginning of the course. Students showed increasing levels of emotional valence after each collaborative learning task; however, they only reported significantly higher situational interest after the first task. Furthermore, the relationship between students’ emotional valence and their individual interest frequently decreased after collaborative learning tasks. The findings suggest that collaborative learning could be a potential factor in changing situational interest. Areas for further research are provided.

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Introduction
Interest to learn is critical for today’s world when the need for continuous learning and skill development is growing enormously (OECD, 2020). Research has shown that interested learners seek learning opportunities (Ainley & Ainley, 2011a; Renninger & Hidi, 2019; Silvia, 2006), engage in meaningful learning (Azevedo, 2013a, 2013b; Trautwein et al., 2015), and regulate their learning better (Bernacki & Walkington, 2018; Durik & Jenkins, 2020; Sansone et al., 2015). Interested learners are also intrinsically motivated: they are more effortful, resistant in the face of challenges, and more often set and achieve goals (Durik & Jenkins, 2020; Harackiewicz et al., 2008; Renninger & Hidi, 2020; Sansone et al., 2015).

However, the problem that inspires this research is that, while there is a strong argument on the relationship between interest and learning, less is known on how interest changes as a part of the learning process in specific learning environments. Researchers have repeatedly emphasized the need to focus on authentic learning settings and interventions that may help students to get interested in school topics through everyday meaningful activities (Brown, 1992; Patrick & Middleton, 2002). Moreover, developmental conceptualizations of interest (Hidi & Renninger, 2006; Krapp, 2007) describe interest as a construct that can change due to environmental stimuli. Identifying educational practices that are beneficial for interest could be particularly timely, as research results have indicated a decline in school students’ motivation in recent years (Ainley & Ainley, 2011b;
Gillet et al., 2012; Gottfried et al., 2007; Scherrer & Preckel, 2019), especially in the area of science learning (Liou et al., 2020; Teppo et al., 2021; Vedder-Weiss & Fortus, 2011).

One of the educational practices that can potentially confront motivational decline and increase students’ interest is providing students opportunities for collaborative learning. During collaborative learning students actively engage in group work towards a shared goal and interact with other peers (Dillenbourg, 1999; Kirschner et al., 2009). These social interactions have been found to shape students’ motivation (Nolen et al., 2015; Steinmayr et al., 2019), especially when students have an opportunity to discuss their experiences, ask questions, and share new knowledge during the learning process (Gambrell et al., 2000). However, less attention has been paid to how collaborative learning can serve as a context for students’ interest change. Hence, in this study, we aim to explore how lower secondary school students’ interest varies in the course of a science collaborative learning project and how this variation is connected to students’ more stable interest forms.

**The Multifaceted Nature of Interest in Learning**

Interest represents a multifaceted motivational construct that can take situational or more static forms (Palmer, 2004; Romine et al., 2019; Rotgans & Schmidt, 2017b) and includes both affective and cognitive components. Interest is also interlinked with other motivational constructs (Ainley, 2006), such as self-efficacy, autonomy, competence, and social relatedness (Bandura, 2012; Minnaert et al., 2007). The development of situational interest into more static forms is described in the four-phase model of interest development (Renninger & Hidi, 2011). The model shows how environmentally triggered situational interest evolves into maintained situational interest and can gradually grow to emerged or even well-developed individual interest, which is a relatively stable disposition towards a specific domain (Hidi, 2006; Krapp, 2007).

The model of interest development has been empirically tested by several studies. In one study, Rotgans and Schmidt (2017a) reported that repeated situational interest arousal enhances individual interest. Still, the empirical findings indicate a more complicated reciprocal relationship between situational and individual interest. Linnenbrink-Garcia et al. (2010), in their study of high school students, provided support for a model in which situational interest predicted a change in individual interest in mathematics during the academic year. Likewise, in a recent experimental study, Bernacki and Walkington (2018) reported that in a personalised learning environment, high school students’ situational interest positively predicted their individual interest during an algebra course. In contrast, Ainley et al.’s (2002) research of Australian and Canadian secondary school students’ interest in a text-learning context revealed that individual interest influenced situational interest. The study also revealed a small but significant effect of individual interest on students’ affective responses. More recently, Romine et al. (2019) found that middle school students’ individual interest in science facilitated their situational interest during a 2-week instructional sequence, which subsequently had a positive effect on their learning.

Situational interest and individual interest both have an affective component (Ainley et al., 2002; Hidi, 2006; Krapp, 2007; Renninger & Hidi, 2011). Situational interest, in particular, has been associated with heightened affective states (Fredrickson & Branigan, 2001; Silvia, 2008; Valiente et al., 2012). Moreover, the polarity of emotional valence, which differentiates positive and negative emotions, appears crucial in situational interest development (Linnenbrink-Garcia et al., 2016). Emotions with positive valence are commonly related to situational interest and support its transition into more stable forms (Hidi & Harackiewicz, 2000). For instance, in three studies conducted at different educational levels, ranging from middle school to college, Linnenbrink-Garcia et al. (2010) demonstrated that triggered situational interest is an affective experience based on positive emotional reactions. Consistent with these findings, researchers have reported a close relationship between enjoyment and situational interest (e.g., Dimmock et al., 2013; Tulis & Ainley, 2011). For example, in Ainley and Ainley’s (2011b) study, based on PISA 2006 data, enjoyment had a positive
effect on situational interest mediated by individual interest, once again evidencing the complex effective relationships between these variables.

Traditionally, interest has been investigated in relation to different learning domains, and science has been a frequently studied content area. Research has identified several factors that increase students’ interest in science, such as family support (Dabney et al., 2013; Dabney et al., 2016), scientific curiosity (Williams et al., in press), course composition (Jansen et al., 2019), and social involvement during in-class activities (Azvedo, 2015; Palmer, 2009). However, less research has explicitly targeted collaborative learning settings or investigated how learning settings that emphasise social interaction impact students’ situational and individual interest. More research is needed to unpack how situational interest is influenced by collaborative learning on the one hand and the level of individual interest in the domain on the other.

Collaborative Learning as a Possible Source of Emerging Situational Interest

Collaborative learning implies a rich, problem-based environment in which students continuously communicate to achieve a common learning goal (Dillenbourg, 1999; Kirschner et al., 2009; Nokes-Malach et al., 2015). In collaborative learning, students can engage in high-level cognitive processes and co-construction of knowledge supported by the teacher (Roschelle & Teasley, 1995; Weinberger et al., 2009). Thus, collaboration has the potential to support individual and group learning (Howe & Zachariou, 2019; Miyake & Kirschner, 2014). Moreover, collaborative environments are regarded as beneficial for triggering and sustaining students’ interest through student interactions (Järvelä & Renninger, 2014; Renninger et al., 2019). This notion has been supported by Bergin (2016), who highlighted how social experiences could act as the key element in transforming situational interest into enduring individual interest.

Some empirical studies support the abovementioned theoretical assumptions. For example, tutors interviewed by Huysken et al. (2019) noted a heightened interest level among undergraduate students participating in collaborative project-based science courses compared to those receiving traditional instruction. In Palmer’s (2009) study, Australian secondary school students commonly mentioned social involvement as a source of their situational interest during a science course. Also, focusing on earlier phases of interest development, Renninger et al. (2019) found that group work was among the primary triggers of secondary school students’ situational interest during collaborative biology experiments.

There are some indications that collaborative learning contexts can be prominent environments for situational interest. However, collaborative learning does not always bring the desired results because students’ reactions to the same situation may differ (Barron, 2003; Khosa & Volet, 2014; Näykki et al., 2014). That is, conditions that increase interest in some students may decrease others’ willingness to engage in a collaborative learning process (Järvenoja et al., 2013; Järvenoja & Järvelä, 2009). Furthermore, collaboration with others can create various interpersonal issues that may affect individual students’ emotional experiences (Mänty et al., 2020), potentially affecting their interest development.

More empirical evidence is needed to determine how collaborative learning acts as a source and a context for students’ situational interest. Therefore, in the present study, we aim to expand our understanding of how students’ situational interest and emotional valence vary in collaborative learning and how they relate to individual interest. We address the following research questions:

1. How do students’ situational interest and emotional valence vary before and after collaborative learning tasks?
2. How do students’ situational interest and emotional valence relate to individual interest before and after collaborative learning tasks?
To answer these research questions, we assess situational interest and emotional valence before and after five subsequent collaborative learning tasks and examine their relationship to students’ individual interest. To this end, we employ a repeated-measurement design and investigate a sample of lower secondary school students through a science course.

Method

Participants and Procedure

The participants were 13-year-old students ($N = 94$; 61.7% female) from five seventh-grade classes. Students came from similar socio-economic backgrounds and were studying at the same public lower secondary school situated in an urban area in Northern Finland. Additionally, four science teachers from the same school volunteered to participate in the study. Based on students’ previous grades, the teachers assigned them to 30 inter-mixed three- to four-member groups. In these groups, the students took part in a science course on light and sound topics that lasted approximately 7 weeks. Students participated in five 90-minute collaborative learning sessions during the course. The collaborative learning design was based on the flipped classroom structure, which involves students acquainting themselves with content knowledge at home and participating in collaborative problem-solving activities in the classroom (Erbil, 2020).

Each collaborative session consisted of three phases. In the first phase, teachers provided a standard set of instructions and introduced the session’s topic. In the second phase, students worked for 60 min in their groups on a collaborative learning task, answering self-report questions on their tablets at the beginning and the end of the task. In the third phase, teachers gave the correct answers and concluded the session. The coordination of collaborative work was supported by the Qridi® technology-based environment, which students accessed through tablets. Qridi® offers tools for self, peer, and teacher evaluations. However, in the present study, the Qridi® platform was used to make the structure of the collaborative sessions visible to students and to measure their situational interest in a non-intrusive way.

All data were collected under the guidelines of the Finnish Advisory Board on Research Integrity (2019). The information letter was sent to the students and their guardians and the written consent for participation in the data collection was received. ID numbers guaranteed the anonymity of subjects during data processing. Participation was voluntary, and the students could refuse to continue the experiment at any point; 94% of the targeted students participated in the study.

Measures of Students’ Situational Interest and Emotional Valence

The measurement of situational interest and emotional valence was based on self-reports of students’ subjective experiences. A single-item measure for emotional valence (Pekrun et al., 2011) and situational interest (Tapola et al., 2013) was applied using the Qridi® tool. Specifically, before and after each collaborative learning task, each student used a tablet to report their current level of emotional valence and situational interest with a 100-point slider (Figure 1). It was clarified that students’ answers would not influence their grades and that there was no correct or wrong answer. Our measurement choice was based on recommendations (Alexander et al., 1994; Goetz et al., 2016; Palmer, 2009) of single-item measures for situative constructs and earlier recognition of such measures as an appropriate instrument (Ainley et al., 2002). The reliability of the self-report measurement was tested by the test-retest reliability approach. Interclass correlation coefficient (ICC) estimates and 95% confidence intervals were calculated using SPSS 25.0 (IBM Corp., 2017) based on an absolute agreement, two-way random-effects model. Emotional valence measurement showed a high degree of reliability. The average measure ICC was .892 with a 95% confidence interval from .831 to .936 ($F(40,360) = 11.381, \ p < .001$). Situational interest
measurement also showed a high degree of reliability. The average measure ICC was .882 with a 95% confidence interval from .816 to .932 ($F(36,324) = 9.493, p < .001$).

**Measure of Students’ Individual Interest**

Students’ individual interest was assessed 3 weeks before the science course via a questionnaire. The individual interest scale was adapted from the Task Interest Inventory (Cleary, 2006). It included six items with a five-point response ranging from 1 (totally disagree) to 5 (totally agree): “It is fun to learn new things in physics and chemistry”; “I enjoy studying physics and chemistry”; “Physics and chemistry are boring”; “It is interesting to learn how to understand physics and chemistry phenomena”; “Studying physics and chemistry is fun also when the topic is difficult”; and “I always look forward to physics and chemistry lessons”. The negatively worded item (“Physics and chemistry are boring”) was reverse scored. As we adapted an existing scale to the Finnish language, we performed a confirmatory factor analysis (CFA) with Amos 26.0 to examine how well the scale fit the data. The path coefficients of the individual interest items ranged from .77 to .93, which was above the .30 breakpoint (Kline, 2005). The CFA showed a good fit between the model and the data, $\chi^2 = 16.41, df = 9, p = .059$, normed fit index = .96, comparative fit index = .98, root-mean-square error of approximation (RMSEA) = .094 with $p$ of Close Fit = .146. The reliability estimate for the individual interest scale was excellent ($\alpha = .93$).

**Data Analysis**

First, we screened our data set for missing values, outliers, and distribution. Table 1 shows the number of cases, means, medians, and standard deviations for all variables. Concerning the questionnaire data, missing values were nearly 6% for the individual interest scale. Little’s Missing Completely at Random (MCAR) test indicated the random nature of the missing values for the individual interest scale, $\chi^2 (21, n = 91–92) = 10.84, p = .966$. Regarding situational interest and emotional valence, the amount of missing data varied for different measurement points (T1: 9–10%; T2: 12–19%; T3: 14–20%; T4: 12–21%; T5: 23–25%). The MCAR test indicated the random nature of the
missing values for the situational interest, $\chi^2 (202, n = 70–87) = 216.87, p = .225$, and emotional valence, $\chi^2 (184, n = 71–87) = 157.35, p = .923$. Having identified that some data was not normally distributed, we opted for a non-parametric analysis.

To assess the differences between students’ pre- and post-evaluations of situational interest and emotional valence, we conducted a Wilcoxon signed-rank test. We calculated the effect size ($r$) by applying the formula recommended by Pallant (2010, p. 225). We transformed the individual interest scale into factor scores, which were used in further analysis. Next, we used Spearman’s correlation analysis to investigate how situational interest and emotional valence relate to individual interest. Finally, we compared correlations before and after the collaborative learning tasks by applying the test of the difference between two dependent correlations with one common variable (Lee & Preacher, 2013, September).

**Results**

**Situational Interest and Emotional Valence Before and After Collaborative Learning Tasks**

The results revealed a statistically significant increase in situational interest only after the first collaborative task ($z = -3.87, p < .001$), with a medium effect size ($r = .3$). Although students were very interested at the beginning of the course, their situational interest became more neutral towards the end of the course. However, the students reported significantly higher emotional valence at the end of each collaborative learning task compared to the beginning. The highest difference was observed during the first two tasks, with a medium effect size ($z = -6.01$ and $z = -4.23, r = .46$ and $r = .34$, respectively, $p < .001$). Over the collaborative course, the effect size for emotional valence diminished from $r = .46$ to $r = .17$. That is, students’ emotional reactions became less evident and more neutral towards the end of the course. Table 2 presents the results of the Wilcoxon signed-rank test analysis.

**Situational Interest and Emotional Valence Relationship with Individual Interest**

Table 3 demonstrates the comparison of Spearman correlations between individual interest and situational interest and emotional valence before and after collaborative learning tasks. At the beginning of the collaborative learning tasks, the relationship of situational interest and emotional valence to individual interest had mainly a moderate to strong effect size ($r_s = .4−.63, p < .001$). However, at the end of the collaborative tasks, the relationship overall became weaker ($r_s = .22−.5$, with $p = .114$ and $p < .001$). In some cases, the decrease in the strength of the relationship was significant, with $z$ ranging from 2.06–3.66 ($p = .04$ and $p < .001$). Specifically, after the second session,
the relationship between emotional valence and individual interest began to decrease consistently at the end of each collaborative learning task ($z = 2.06–3.66, p = .04$ and $p < .001$), with the most drastic alteration appearing in the last session ($z = 3.66, p < .001$). In contrast, the relationship between situational interest and individual interest only decreased significantly in the third session ($z = 2.33, p = .02$). Overall, no significant changes occurred in either relationship after the first and second sessions. In contrast, most changes took place in the third session ($z = 2.33–3.05, p = .02,$ and $p = .002$), in the middle of the science course.

Discussion

The present study set out to investigate how students’ situational interest and emotional valence vary during collaborative learning and how they relate to students’ individual interest. Our first research question addressed variation in situational interest, particularly in terms of variation in emotional valence before and after collaborative learning tasks. The affective component was highlighted, as previous research has found an association between affect and situational interest (Hidi, 2006; Krapp, 2007; Silvia, 2006). In the present study, students noted a substantial increase in situational interest only after the first session, while they reported an increase in emotional valence after completing each task. These results appear to indicate that emotional valence was the component most responsive to the situational features of the learning context (which was both a science learning domain and a collaborative learning context).

When considering emotional valence and situational interest as closely linked constructs, we can hypothesize that an enhancement in emotional valence signals a possible increase in situational interest. Within the theoretical framework of the four-phase model of interest development (Renninger & Hidi, 2011), students’ triggered situational interest originates from an affective state prompted by an external factor. In line with this view, Bergin (1999) generally acknowledges the role of positive emotions in the enhancement of situational interest. Moreover, in their
empirical study, Linnenbrink-Garcia et al. (2013) noted that situationally interested students also experienced positive feelings. Similarly, in another study, Linnenbrink-Garcia et al. (2016) identified positive activating emotions as a factor activating interest in the learning activities. Furthermore, they emphasise the contextual factors involved in creating emotional reactions that are beneficial for motivation. Nevertheless, more research is needed to unpack how these context- and situation-specific features actually make a difference in the emotional reactions of individuals, gradually building situational interest. There is a particular need for research that relates individual group members’ situational motivation within social interaction, which is a context that can trigger various emotional reactions among individuals (Järvenoja et al., 2019; Mänty et al., 2020; Volet et al., 2019).

We can also consider emotional valence and situational interest as separate constructs. In this case, a plausible explanation for the observed variation could be that emotional valence is a more fluctuating phenomenon than situational interest, which is less responsive to external stimuli. Similar to the present study, Fulmer and Tulis (2013) found that students’ affect increased after a reading task, while their situational interest remained relatively stable. They also found that secondary school students’ situational interest ratings remained stable during a computer-based science simulation class. This was similar to students’ genre-specific liking during a collaborative writing programme researched by Hidi et al. (2002). These studies, however, did not implement a process-oriented approach to combine interest evaluation with other actualised processes of learning to complement the subjective measures. To capture situational interest variation, regardless of seeing affect as separate from interest or as part of the situational interest, future research could benefit from utilising more situated measurement points during a collaborative task and using multimodal data sources (Järvelä et al., 2019).

An important aspect of the findings is the role of context in the observed situational interest and emotional valence variation. Prior research has related motivational and emotional changes to the collaborative learning process (Arpiainen et al., 2013; Järvenoja & Järvelä, 2005). For example, Nummenmaa and Nummenmaa (2008) found a positive association between undergraduates’ emotional reactions and collaboration. In their research, valence fluctuation predicted collaborative activities in a web-based learning environment. In the present study, students may have felt more positive because they enjoyed working together in collaborative learning groups, although collaborative learning did not have enough power to significantly change students’ situational interest in the task itself. Alternatively, students’ positive emotions may not have been explicitly connected to the collaborative learning content, which could explain their insufficiency in enhancing students’ situational interest (Hidi & Renninger, 2006). Instead, the substantial increase in students’ situational interest only after the first session likely indicates the novelty effect of the intervention. We can see a similar scenario in Fryer et al.’s (2017) research: having measured undergraduates’ situational interest before and after a chatbot speaking task over a 12-week course, the authors discovered a significant drop in situational interest after the first class and linked it to the novelty effect. The novelty effect could also explain the observed increase in situational interest and emotional valence after the first two collaborative learning sessions and smaller variation during the rest of the science course.

The second research question concerned how situational interest and emotional valence relate to individual interest. The findings show that while students’ situational interest and emotional valence were positively related to their individual interest at the beginning of the collaboration, the relationship typically decreased or even disappeared by the end. This finding indicates that students’ individual interest plays an important role in their initial level of emotional valence and situational interest but does not necessarily determine them for the duration of the lesson. This is in line with Knogler et al.’s (2015) finding that the learning environment is the primary factor of students’ situational interest. Specifically, Knogler et al. (2015) argue that although individual interest can create consistency in situational interest (see also Mitchell, 1993), individual interest is mostly unrelated to the situation-specific components of situational interest. Similar to the results of the present
study, Rotgans and Schmidt (2018) found that individual interest only impacts situational interest significantly at the beginning of a task. Likewise, Chen et al. (2016) found that while students’ initial individual interest predicted their situational interest, situational interest subsequently predicted students’ individual interest at the end of the task.

In the present study, the link between individual interest and situational interest significantly decreased only after the third session. In contrast, the relationship between students’ individual interest and emotional valence became weaker more frequently. The reason for this could be that emotional valence compared to situational interest is impacted more by collaborative learning characteristics than by students’ individual interest. For instance, Volet et al. (2019) found that first-year university students’ emotional experiences were influenced by the activities and group characteristics in a collaborative learning science course setting.

The present study did present some limitations. First, the situational interest and emotional valence assessment conducted at the beginning versus the end of the task limited inferences regarding the actual process of fluctuation. For the same reason, it was difficult to identify the exact moment when the relationship between individual interest and situational interest and between individual interest and emotional valence decreased and if there were several alterations in the relationship during the process. To focus on situational interest fluctuation, some researchers (e.g., Knogler et al., 2015; Rotgans & Schmidt, 2014) have suggested using multiple measurement points during the task. Moreover, Schraw and Lehman (2001) note that it might be necessary to follow students over a longer period to determine interest development. The extended time of investigation is also preferable, as this diminishes the potential impact of the novelty effect (Bracht & Glass, 1968). We stress that inferences regarding an increase in situational interest greatly depend on the theoretical approach used in a particular study. That is, applying an emotional conceptualisation of situational interest would lead to firmer conclusions regarding situational interest changes after collaborative learning. Finally, having not investigated causal relationships, the present research cannot empirically confirm a specific factor that decreased the relationship between situational interest and individual interest and between emotional valence and individual interest.

These limitations notwithstanding, our study builds on the existing literature in several ways. First, the study shows that students’ situational interest and emotional valence vary before and after collaborative learning tasks, supporting the conceptualisation of motivation as a continuum from fluctuating and task-specific constructs (Järvelä et al., 2008; Nolen, 2020) to relatively stable motivational beliefs that relate to situational experiences (Artino et al., 2010; Boekaerts, 2002). Specifically, the study illustrates how emotional valence changes more frequently than situational interest after collaborative learning, which raises questions regarding the role of the affective component in situational interest (Renninger & Hidi, 2011). Second, our research shows that during collaborative learning, students’ situational interest and emotional valence become more independent of their individual interest, providing a new perspective on the relationship between these constructs (Renninger & Hidi, 2011). Overall, the study results highlight how collaborative learning can serve as a context for students’ interest.

At a more general level, we believe that understanding how students’ interest develops and is affected by the situational characteristics of their learning context is essential, as there is evidence of a decrease in students’ motivation, particularly in science learning (Liou et al., 2020; Teppo et al., 2021; Vedder-Weiss & Fortus, 2011). Even countries with high-performing students, such as Finland, face motivational issues. According to the Finnish Ministry of Education and Culture (2016), 15-year-old students in Finland are substantially less motivated to study science than their peers in other OECD countries. Moreover, PISA 2015 results indicate that motivation had a great effect on students’ performance in Finland, while socio-economic background was the strongest predictor in other OECD countries. Therefore, motivation is likely to contribute to the decline seen in Finnish students’ PISA performance from 2000 to 2018 (OECD, 2019). This highlights the need for researchers to examine this topic, particularly in the Finnish context.
Regarding practical implications, the findings suggest that the impact of students’ individual interest on their situational interest and emotional valence is modifiable and that subsequent learning can be moderated through educational interventions. One effective method is collaborative learning. Still, to avoid interest drop over time, teachers might consider enhancing collaborative learning with other techniques to increase students’ interest, such as classroom simulations (e.g., Lo & Tierney, 2017) and games (Mivehchi & Rajabion, 2020; Vidergor, 2021). Future research should explore how individuals’ general motivational beliefs influence the actualised collaborative learning processes and how these processes affect students’ situational experiences.

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