CAPTURING TEACHER STUDENTS' EMOTIONAL EXPERIENCES IN CONTEXT: DOES INQUIRY-BASED LEARNING MAKE A DIFFERENCE?

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In the present study teacher students' contextual learning experiences were examined longitudinally in authentic study environments using the Contextual Activity Sampling System (CASS), a means of mobile-supported experience sampling. The students' (n = 9) experiences were first recorded during a two-week period in their first year of study. The same measurements were repeated again for a two-week follow-up in the second year, accompanied by interviews before and after the follow-up. The first year of study consisted mostly of lectures and ordinary small-group work, whereas the second measurement period ran parallel to the completion of an intensive inquiry-based project, which was the focus of the present study. A multivariate analysis of variance (MANOVA) revealed that studying during the inquiry-based period produced stronger experiences of being challenged as well as negative affects than the teacher-centered period. The participants' experiences of competence, commitment and positive affects did not differ during the two periods. However, interview data indicated that the participants enjoyed the inquiry-based period and that the work was intensive. Contextual data and interviews were also used to describe students' experiences during one particular study session during the inquiry-based project. The results suggest that negative affects may be an essential part of the process of gradually learning to take responsibility for both individual and collaborative learning processes. Possibilities for using experience-sampling methods to analyze collaborative learning are also discussed.
Introduction

What do students actually feel and experience in the university classroom? Student-centered, activating studying is often assumed to promote motivation and deep-level learning. However, the results on the effects of student-centered practices and methods designed to support active and constructive learning are mixed (Dochy et al. 2003; Gijbels et al. 2008; Struyven et al. 2006). It appears that these methods do not always achieve the desired outcomes, and they have been criticized as less effective than more traditional, teacher-centered guidance (Kirschner et al. 2006). On the other hand, evaluating the outcomes of innovative learning methods is not simple, and also calls for methodological innovation. Further, how can we define the desired outcomes? Not only are cognitive or academic outcomes important, but emotions and motivation may play a role. Thus a need has been raised to carefully study the various aspects and students’ experiences of different learning environments (Bereiter & Scardamalia 2000; Loyens & Gijbels 2008; Renkl 2009). In the present paper we are hoping to go beyond retrospective generalizations by introducing process-sensitive data on student learning. Our aim is to situationally and contextually capture the varying cognitive and socio-emotional experiences of learning.

The study follows how a group of students experienced shifting from teacher-centered learning to inquiry-based learning over two years. In the first year a more teacher-centered study period was investigated, involving lectures and regular small-group work. In the second year, an intensive inquiry-based study period was in the focus of the research. We examined how contextual time series data may be utilized to study collaborative learning in higher education. We wanted to assess students’ experiences concerning challenge and competence as
well as their associated academic emotions. We first examined how experienced emotions, challenge, and competence appeared in a teacher education context. Second, we introduced a process for sampling learning experiences contextually, based on mobile devices. These were used to measure the participants’ learning experiences in their actual study environments and to analyze experiences associated with inquiry-based learning in teacher education.

**Emotions in the academic environment**

Studying and learning are not merely cognitive activities; rather, students experience a wide range of emotions while studying (Pekrun et al. 2002). These academic emotions refer to emotions that are directly linked to academic learning activities (e.g., pride in success, or test-related anxiety) and they appear to be strongly domain-specific. That is, certain emotions such as enjoyment and boredom are experienced repeatedly in certain types of learning environments (Goetz et al. 2006). In addition, academic emotions are closely related to motivation, engagement and achievement in learning situations (Eynede & Turner 2006; Pekrun 2006). The actual interplay between emotions, engagement, and performance is complex and multifaceted. However, it appears that if a learning situation triggers enjoyment and diverse emotions (e.g., happiness, sadness, disgust or surprise), students’ interest and task involvement are fostered (Pekrun 2005).

In this study we categorized emotions into two main dimensions: positive and negative affects (Watson et al. 1988) although many other dimensions for describing emotions have been used (see Barrett 2007). According to Watson et al. (1988) a high positive affect means an energetic state, full of concentration and pleasurable engagement, whereas a low positive affect is characterized by sadness and weariness. On the other hand, a high negative affect
is a general dimension of subjective distress, such as anger, fear, and nervousness, with a low negative affect being a state of calmness and serenity. We are aware, however, that both positive and negative affects may be related to interesting and engaging learning experiences (Lindblom-Ylänne & Lonka 2000; Pekrun 2005).

*Challenge and competence during studying*

In study situations, emotions are very often based on the balance between the challenge the situation presents on the one hand, and learners’ feelings of competence on the other. Moneta and Csikszentmihalyi (1996) discovered that an imbalance between the two, that is, if the task is perceived as too easy or too challenging, often leads to a decrease in concentration and involvement. However, they also showed that situations in which the challenge is slightly too high, are better for concentration (Moneta & Csikszentmihalyi 1999).

In addition to the interaction between challenge and competence, another important aspect is the actual levels of the two. Moneta and Csikszentmihalyi (1996) found that high levels of feeling challenged and competent were positively related to concentration and involvement. Furthermore, high-challenge and high-competence situations are far more salient and intense compared to medium-level experiences (Moneta & Csikszentmihalyi 1999). Such situations, accompanied by a sufficient experience of competence are likely to engender full concentration and absorption, which can also be referred to as a flow experience (Csikszentmihalyi 1988).

In conclusion, it appears that intense, affect-provoking and challenging situations are likely to focus the learner’s attention. Enjoyment is an important aspect of an engaging learning experience. If studying offers merely excessive challenges, it may cause frustration and a loss of concentration. In this study we
focused on how varying instructional formats may promote different experiences in terms of affects and feelings of being challenged and competent. Of particular interest was how students would experience shifting from a teacher-centered setting towards a learner-centered inquiry-based instructional format, which also was more ill-defined.

The dynamic interplay between learners and learning environments

Learning environments consist of the practices of teaching, learning, and assessment as well as the physical learning environment. Biggs (1993) used the concept “constructive alignment” to describe an ideal learning environment in which the learning materials and other aspects of teaching and assessment are aligned to and support deep approaches to learning. Entwistle (1998) further emphasized the importance of taking into account students’ perceptions of the learning environment in analyzing student learning.

Vermunt and Verloop (1999) developed the concept of friction. Destructive friction occurs when the learning environment is too strictly or too loosely structured in relation to the students’ self-regulation skills and therefore does not match the needs of the learner. An ideal learning environment would, instead, provide shared control, where teachers facilitate and promote learning by using activating and student-centered methods, in order to help all types of students develop their study strategies and self-regulatory skills. This would create constructive friction: an urge to gradually develop more and more sophisticated thinking and study skills. Lindblom-Ylänne and Lonka (2000) proposed that situations in which students experience constructive friction also might result in stress and negative affects, when the students are struggling at their upper limits of their competence. From the student’s perspective, the major difference between
a traditional teacher-centered course design and a more open learning environment is the level of structure given to the students and the degree to which the student is expected to take control of the study process (Vermunt & Verloop 1999).

**Promoting meaningful learning**

Student-activating methods are increasingly being used in university teaching. The goal of using such methods is to engage students and give them a sense of personal control over their learning. Teachers develop interest by explaining the purposes of a task at hand and scaffolding students' understanding by activating prior knowledge, supporting students' own thinking, and providing transparent goals (Tsai et al. 2008).

Instructional formats do not always result in the desired outcomes. Although using a deep-level approach should be increasing, the opposite is sometimes true and students end up using more surface-level strategies characterized by memorizing facts without seeking the implications of what is learned (Baeten et al. 2008; Struyven et al. 2006). And although students’ attitudes towards deep-level learning become more favorable after a course, the students do not necessarily change their learning styles towards deeper levels of processing (Gijbels et al. 2008). Lonka and Ahola (1995) showed that positive learning results from the activating methods employed were evident only after several years of participating in activating courses. They also showed that the learning results were more procedural than declarative in nature, that is, students appeared to learn study skills instead of merely increasing their factual knowledge. Activating instruction may not be enough, if we truly want to promote change in ways of thinking. Questions pursued through activating instruction are
rarely constructed by the students themselves, even though their thoughts are activated, diagnosed and taken into account in instruction (Lonka et al. 2000). Inquiry-based learning is much more likely to promote striving towards a more thorough understanding.

Inquiry-based learning may be defined as “an array of classroom practices that promote student learning through guided and increasingly independent investigation of complex questions and problems” Lee (2004, p. 9). Inquiry-based settings can be categorized as structured, guided and open inquiry ranging from a structured setting in which the issue and methods are set by teachers to an open setting in which the students formulate the questions and the ways in which they are addressed (Sponken-Smith & Walker 2010). The nature of the investigated question varies accordingly from having a closed, predefined correct answer relying on existing knowledge to an open one in which the students must generate new knowledge in order to clarify the issue.

The present study focuses on the open inquiry process, known as progressive inquiry-based learning (Muukkonen et al. 2005). As a learning environment, it is an intentionally ill-defined setting in which the students take responsibility for planning, executing and evaluating their own learning. During this process, the initially vague questions typically break up into several subordinate questions, which become a basis for focus-deepening question-explanation process (Hakkarainen & Sintonen 2002).

Contextual sampling of learning experiences

Various methods for gathering process-sensitive data from participants in their natural environments have been increasingly introduced during the last decades (Bolger et al. 2003). One of the most widely used is the Experience Sampling
Method (ESM) (Hektner et al. 2007). This involves repeated sampling of segments of participants’ activities including cognitive activities, socio-emotional experiences, and external actions in the context of everyday activity. Traditional methods in learning research often require participants to make global generalizations of their past activities (e.g., how do you prepare for an examination?). Retrospective biases are reduced when event-sampling studies ask participants only to report their momentary psychological states in the context of their ongoing activity, and observations are aggregated across relatively long periods of intensive follow-ups (Reis & Gable 2000). Nevertheless, ESM has relatively rarely been used in research on situational and contextual aspects of collaborative learning.

**Research Aims**

As described above, there is conflicting evidence about the usefulness of student-centered instruction. We wanted to determine whether a variation in emotions and motivational experiences would play a role when the same teacher students would be introduced to increasingly student-centered ways of learning. The present study explored students’ experiences while shifting from a teacher-centered to inquiry-based period. The teacher-centered period was in the first study year, and the inquiry-based period in the second. The aims of the study were as follows.

1. To explore how students experience teacher-centered instructional arrangements as compared to inquiry-based learning.
2. To explore how experience-sampling data could be used to describe students’ experiences of collaborative learning.

We anticipated that the students would experience intense affects when moving from teacher-centered to the inquiry-based study. We also anticipated that the
participants would experience greater challenges in the inquiry-based conditions. It was assumed that the experiences would differ only in study-related situations, and that no difference would be found when participants were not studying.
METHODS

Participants
The participants were nine (N=9) teacher students at the University of Helsinki, Finland, who volunteered to participate in a 2-year longitudinal comparative study, part of a large 4-year research program. Data collection took place when the students were in their first and second year of a five-year Master’s program. The participants were aged from 19 to 28; five were female and four were male.

Study context
The study took place in a teacher education program with a yearly intake of 10 students having educational psychology as a major. Studying is arranged in an intensive ten-student group for the first three years of five-year Master’s degree studies. The students study intensively as a small group for three years, applying progressive inquiry-based learning as one of their main approaches. The program includes both Bachelor and Master studies. Descriptions of some of the processes, which emerge in this intensive group process, have been reported elsewhere (Rauste von Wright 2001; Eteläpelto et al. 2005; Lipponen & Kumpulainen 2011). Concerning progressive inquiry-based learning, see Muukkonen et al. (2005).

The present study focused on comparing teacher students’ contextual learning experiences across two 14-day follow-ups, the first (year 1) consisting mostly of lectures, and the second (year 2) focusing on an intensive inquiry-based project. The first was between January and February of the first year of the study
program, and the second was conducted during the same time in the second undergraduate year.

During the first-year follow-up, the students studied various subject-matter based courses in the teacher-training program, including physical education, drama education, scientific writing, introductory methodology and educational psychology. Both lectures and small-group sessions were involved. The courses were evaluated by the teachers on the basis of examinations and essays.

During the second follow-up, the students focused on a progressive inquiry-based project of which object of inquiry was how affects influence learning. They adopted a multidisciplinary perspective, integrating the disciplines of mathematics, history, art and neuropsychology. In addition to broadening their own academic knowledge, the group considered ways to design inquiry-based learning contexts for elementary school students on the same topic. While the teachers had given the schedule during the first-year follow-up, during the second year follow-up the students were responsible for arranging the study schedule. The student teachers worked collaboratively with university lecturers and approached their inquiries from multiple perspectives. Each lecturer also met the students individually three to four times during the course. Altogether, these different ways of working gave the students opportunities to engage in dialog and exchange opinions with other members of their learning community. Between meetings the students conducted (individually and collaboratively) such tasks as, searching for scientific information, reading articles, and writing essays, which were then discussed in meetings together with the lecturers. The students also together produced a portfolio describing the process. At the end of the project an
evaluation meeting was held in which the students and teachers together discussed and agreed on a common grade for the whole group.

**Procedures**

Contextual data on the participants’ learning experiences were collected with the Contextual Activity Sampling System, CASS (Muukkonen et al. 2008). This research instrument has been designed to collect frequent and systematic data on ongoing educational and professional activities. The CASS-Query tool is a Java application that runs on 3G mobile phones with a Symbian operating system. It sends queries to participants’ mobile phones, after which the answers are sent to a server database.

In January of their first and second year of studying, the participants were asked to take part in two-week periods using the CASS system. They were given mobile phones (Nokia E70) that notified them to respond to questionnaires concerning their study processes in terms of challenge and competence as well as their academic emotions, five times a day. The three-hour pre-defined intervals were customized according to a schedule the student preferred (e.g., 9.00, 12.00, 15.00, 18.00, 21.00). During the first-year data collection period, the first (morning) and last (evening) questionnaire differed slightly from the three daily day questionnaires and lacked some of the items. Therefore the morning and evening data could not be used in the Multivariate analysis of variance (MANOVA) when comparing experiences between the two periods. The participants were introduced to the CASS data-collection procedure, queries, and mobile phone use in an introductory session. A feedback session concerning the research procedures was held after each two-week data-collection period. The
participants were asked how they experienced the data collection and how to improve the CASS.

Altogether, 1010 observations were collected from the nine students during the two periods (508 the 1st year, 502 the 2nd). Of these, 610 were day questionnaires, which could be used for the MANOVA. The number of queries sent was 630 each year. The response rate was thus 80.2%, ranging between subjects from 48.6% to 96.4%. Although the participants’ individual response rates differed from one another, the response activity remained stable at within-subject level between both research periods ($\chi^2=7.314$, df=8, p=.503). Therefore it is assumed that individual answering tendencies did not differ between data collection periods and that differences in response rates did not cause errors in the analyses.

**Materials**

The questionnaire (described by Muukkonen et al. 2008), employing the CASS methodology, focused on issues concerning context and experiences. Firstly, the participants were asked to write down what they were doing. Secondly, multiple-choice questions were posed to define the participant’s context (*Where are you? Are you studying?*). In the first year’s data collection (i.e., teacher-centered format), however this question was not asked in the first (morning) and last (evening) daily questionnaire. Thirdly, affects were measured using a PANAS scale (Watson et al. 1988), which focuses on Positive (*interest, enthusiasm, determination, energetic*) and Negative affects (*stress, irritation, nervousness, anxiety*). Fourthly, the questionnaire addressed the aspects of about Competence (*How competent do you feel?*), Challenge (*How challenging is the situation?*), Importance (*How important is this to you?*), and Commitment (*How committed are you to doing this?*). The items concerning affects, competence, challenge,
importance and commitment were answered using a seven point Likert scale ranging from \( l=\text{not at all} \) to \( 7=\text{very much} \).

**Interviews**

In addition to the CASS process, each participant underwent a semi-structured interview before and after the inquiry-based period in the second year. The interviews before the follow-up focused on how the students experienced their studies in general, while the interviews after focused especially on their experiences during the two-week period. The interviews before the follow-up typically lasted 45 minutes and those after approximately 30 minutes. The interviews were recorded and transcribed.

The transcribed interviews were analyzed qualitatively using a phenomenological approach (Smith & Osborn 2008) focusing on the individual’s descriptions of his or her experiences during the inquiry-based project, and data from both interviews before and after the follow-up were analyzed together. Each individual interview was thoroughly examined, and statements were extracted and placed under three broad thematic headings, derived from the scales used in the CASS questionnaire: 1) positive emotional experiences, 2) negative emotional experiences, and 3) experiences of competence and of being challenged. These themes were then evaluated and described in terms of how they related to aspects of the inquiry-based project. Excerpts from the interviews were used as examples.

**Statistical procedures**

To see whether the students’ study-related experiences differed during the teacher-centered and inquiry-based periods, a 2x2 multivariate analysis of variance (MANOVA) was performed on five dependent variables. The
independent variables were the Instructional format (teacher-centered vs. inquiry-based) and Situation (studying vs. not-studying). The situations in which the students were not studying were included in order to determine whether possible differences between the two periods would result from differences in the study periods or from some other interacting factor such as the CASS methodology.

The dependent variables were Positive affects, Negative affects, Competence, Challenge and Importance. Only the three daily day-observations (altogether 610) were included in the analysis because morning and evening measurements did not include information on whether or not the student was studying. The statistical analyses were completed in five stages: missing value analysis, creation of sum variables, outlier analysis followed by a multivariate analysis of variance, and a time series analysis.

Firstly, missing values were considered. No missing variables were found concerning the independent variables. In the 16 observations having only one missing value concerning dependent variables, the missing values were replaced using the EM method in the SPSS. In observations (N=32) which had two or more missing values, the values were missing in the last variables of the questionnaire and therefore reflected intentional non-responding. These observations were deleted.

Following the missing value analysis, three sum variables were created. Two sum variables were formed to describe Positive (interest, enthusiasm, determination, energy) and Negative (stress, irritation, nervousness, anxiety) affects. Both were composed of four variables and their Cronbach’s alpha’s variables were .87. The items concerning importance and commitment were summed to measure Importance of a situation for the participant. This variable was named Importance and its Cronbach’s alpha was .80. Items
concerning Challenge and Competence were analyzed as single variables. After the five variables were created they were standardized to z-points on a within-subject level. As a result, every subject’s individual mean was zero and standard deviation one. The standardization also led to a loss of between-subject variance, but because the study focused on how students experienced two different study periods, and not individual differences, this did not cause problems.

One case was deleted as an extreme univariate outlier \( p < .001 \) \((z=5.09)\) and two cases as multivariate outliers \( p < .001 \). The results of the evaluations in terms of normality, homogeneity of variance-covariance matrices, linearity and multicollinearity were satisfactory. Following the missing value and outlier analyses, the number of observations included in the MANOVA analysis was 575. As can be seen in Table 1, the sample sizes were not equal. Although nearly the same number of observations was collected during both periods, the data indicated that the participants studied more frequently during the inquiry-based period. To control the effect of unequal cell sizes, all cells were treated as important in the MANOVA in accordance with Overall and Spiegel (1969).

[Insert Table 1. about here]

**Time series analysis**

Students’ experiences during the inquiry-based study period were analyzed using time-series analysis at a group level. This was done in order to illustrate the group average concerning positive and negative affects, competence, and challenge. Firstly, the mean of observations on a single hour between 8.00 and 23.00 was computed. This resulted in having one value for every hour of every day of the research period, the value being the mean of the observations during that hour.
Following this, a mean was calculated including the values of the two previous and two following hours, resulting in a sliding mean value for each hour. As a result, we were able to formulate a figure describing the mean values for the whole group at a particular moment. On average, every value represents a mean of 13.7 observations, the minimum being 7 and the maximum 22. The moments when the students were working together on the inquiry-based project were also drawn from the data.
RESULTS

The results are divided into three sections. Firstly, the differences between the two follow-ups are described by MANOVA analysis and figures for the mean differences. Secondly, the participants’ descriptions of the period are presented. Finally, time-series analysis and interviews are used to describe the students’ experiences of one particular episode.

The differences in teacher students’ experiences between teacher-centered and inquiry-based periods

The participants experienced study situations during the inquiry-based period as more challenging and affect-provoking than during the teacher-centered period. The MANOVA showed that participants’ experiences differed between the two periods (teacher-centered and inquiry-based) and in the different situations (studying and not-studying). With Wilks’ criterion, the main effects for dependent variables (Positive affects, Negative affects, Importance, Challenge and Competence) were significantly effected by both study period (teacher-centered vs. inquiry-based) \( F(5, 571) = 7.52, p<.001 \) and situation (studying vs. not studying) \( F(5, 571) = 39.52, p<.001 \). Moreover, interaction of the two independent variables was also significant \( F(5, 571) = 2.84, p=.015 \), indicating that study experiences during the two periods differed. The results showed that the study period had a medium effect on the combined dependent variables (partial \( \eta^2 = .075 \) with 95% confidence limits from .033 to .112.), and that the situation (studying vs. not studying) had a large effect on dependent variables (partial \( \eta^2 = .257 \) with 95% cl. from .195 to .310). For the interaction, the association was small (partial \( \eta^2 = .024 \) with 95% cl. from .001 to .046). Because our goal was to determine whether the study-related experiences differed during the two periods, only the interactions’ of independent variables (study period and situation) on
individual dependent variables are presented in the following section. The differences of experiences between the two periods in studying and non-studying situations are shown in Figures 1 and 2.

[Insert Figures 1. and 2. about here]

Figure 1 shows that negative affects were higher while studying during the inquiry-based period compared to the teacher-centered. The figure also shows that there were no statistically significant differences in Positive affects between the two periods in either the situations where the participants were studying or in the situations where they were not. In addition, negative affects remained the same when the participants were not studying. Although they appear to be slightly higher during the inquiry-based period, the variation was well within the range of confidence limits as also confirmed by the MANOVA. The interaction of the period and studying on Negative affects was small but significant \[F(1)=8.88, p=.003\] (partial \(\eta^2=.015\) with 95% cl. from .002 to .041). The interaction of the independent variables on Positive affects was not significant \[F(1)=1.06, p=.305\].

Figure 2 shows that Challenge was higher while studying during the inquiry-based period than during the teacher-centered period. The figure also shows that the levels for Competence and Importance did not differ statistically significantly between the two periods in the studying and not studying situations. This was also true for Competence as confirmed by the MANOVA. The interactions of the period and studying on Importance \[F(1)=.07, p=.794\] and Competence \[F(1)=.139, p=.706\], were not significant. The interaction of independent variables on Challenge was significant \[F(1)=4.56, p=.033\], but very small (partial \(\eta^2=.008\) with 95% confidence limits from .000 to .028).
In conclusion the MANOVA showed that the inquiry-based period evoked more Negative affects and Challenge than the lecture-based period. In addition to these differences, it is worth noting that in situations where the participants were not studying, the values remained at the same level. In other words, experiences outside studying did not differ between the periods.

**Students’ descriptions of the inquiry-based project**

In what follows, the participants’ experiences will be illustrated based on common and frequently mentioned descriptions of the inquiry-based project. Overall, the emotional experiences that the students identified in relation to the project varied and were diverse. Moreover, variation was experienced even within individual meetings. For example, as one participant commented: “Usually the meetings related to our project have varied a lot, and there has been extreme frustration. Or we have lacked a spark, but then it kind of lights up (022).”

*Positive emotional experiences* were described not as relating to a single event or meeting, but more broadly, as relating to studying during the project in general. The participants noted that they were unable to name a single event as distinguishable from the others. While the CASS data revealed only higher negative experiences and challenges, the interviews revealed that the students also enjoyed working on the project. The most frequently used terms were “interest,” “excitement,” “feeling of accomplishment,” “successful collaboration” and “progress in the project.” Positive experiences related to collaboration, autonomy and interest in the topic. Collaboration within the group was considered to be a motivator: “The group works together and everybody has their own role, while all are still doing so many things, and when it is created together it is really, really
cool (031).” This reference also indicates that the group’s cohesion was considered to be strong. The group was not new – the nine students had been studying together for one and a half years. However, many of the students noted that during the inquiry-based period they felt that the group had reached more of its potential than before. The group being autonomous was considered as characteristic of the inquiry-based setting and was seen as a learning opportunity.

In addition to being responsible for the learning process the students also took part in planning the content and how to study it, together with the teachers. While the students experienced autonomy as a group, this was also seen as an individual’s opportunity to have an effect on what was done collaboratively. In many cases these two intertwined and were seen as strongly motivating elements. “Well, in a way I have had an influence on which topic we chose, and in a way it became like my own (081).” The topic was seen as interesting, and having an influence on its selection made it possible to include the interests of different participants. In addition to being interested in the topic at hand, many reported having an interest in the group’s functioning and in the dynamics themselves.

*Negative emotional experiences* relating to the project included feeling busy, tense, tired, unable to keep up or in a state of chaos. While the inquiry-based project was described by intense negative affects, none of the participants mentioned boredom, being disinterested, or other low-intensity negative affects. These, however, were mentioned in connection with other courses outside the studies in the study group, such as lecture courses. Similarly to the positive emotional experiences, the negative experiences were associated with autonomy and collaboration. Autonomy and facing ill-defined problems produced frustration, “but then, at least when I felt that the topic was overwhelmingly
extensive and I could not grasp it, it felt really frustrating (031).” Although the collaborative work was motivating, it was also considered to be difficult and a source of conflict. “Well, we had some such afternoons where it felt like ‘Where is this group going? Has the group lost its ability to do anything, when everybody just shouts at each other?’ (032).”

Experiences of competence and being challenged Experiences of being challenged related mostly to organizing the collaborative work. Working on the inquiry-based project was considered a novel way of working, and one which required extra effort. Organizing the work encompassed covering interests of as many participants as possible, forming a coherent object of inquiry, and at the end of the project sharing the work to collaboratively write a common portfolio of the project. Also, at times the group seemed to face challenges they were unable to handle. In these cases, members reported relying on their lecturers for advice: “And Lecturer X said this might be an easier way to approach this topic, and that of course there are these kinds of aspects to be considered here (071).” In general, challenges were not considered to be too high, but rather at an appropriate level. The group was given a collective grade on a scale from one to five, five being the highest. Members took part in evaluating the process together with the teachers. The students were somewhat critical of the group’s performance, although they considered it a valuable learning experience: “Originally we felt that we were not very successful. That we should give ourselves a three. But when I think about it now we did really well. If I would have to grade the learning experience, it would be a five (012).” One event during the Tuesday afternoon of the second week of the follow-up was especially challenging and distinguishable in both the
interviews and CASS data. It will be described first in the light of the CASS data and then in the light of the interview data.

“Black Tuesday”

The variation of Positive and Negative affects of all nine participants was examined during the second period, when the students were collaboratively involved in the inquiry-based study. Figure 3 presents the sliding mean of the whole group’s affects as a whole. Sequences where the participants worked together are also shown.

[Insert Figure 3. about here]

Figure 3 shows that during the second Tuesday of the inquiry-based period, the participants’ Negative affects were particularly high. It also shows that during the first weekend, the students’ Positive affects were high at the group level while Negative affects were low. However, a similar pattern was not detected during the second weekend. This may be because the project’s final deadline was approaching, and in the interviews the students reported that they were working on their assignments over the weekend. Figure 4 shows the group averages for Challenge and Competence, which were calculated the same way as with Positive and Negative affects.

[Insert Figure 4. about here]

Figure 4 indicates that during the second Tuesday Challenge was above average and Competence was below average. Although the actual levels were similar to
the other situations, it is worth noting that the difference between Challenge and Competence was clearly distinct. On this very day, high levels of Challenge were reported at the same time as the students reported low levels of Competence.

In the interviews after the second CASS follow-up the students were interviewed about their experiences during the two-week period. When the interviewer asked about negative experiences during the second follow-up, five of the nine participants spontaneously raised the Tuesday afternoon of the second week of the follow-up as a stressful experience. The students shared the responsibilities of the meetings so that two were always in charge of a meeting. One of the students who was in charge described things as follows:

That one I remember. These two times (observations during one day). They were really distressing. I mean, nothing worked out. In our group we had a problem, a pretty challenging learning task in mathematics. Some of us were really frustrated and it didn’t seem to work out. I mean I was in charge of the mathematics, and so I and the (other person in charge) got frustrated, because we felt that the others were not trying hard enough. And we had this extra pressure. I think it was because the previous week had been very burdensome. But I think that it really was a difficult learning situation. I mean the mathematics were challenging for us anyway. And it ended up so that we had no time or means to accomplish this. We felt like giving up. (F1)

As is evident from the above extract and Figures 3 and 4, the same Tuesday meeting can be perceived as a negative experience, both in terms of the CASS data as well as the interview.
DISCUSSION

The aim of this study was to compare teacher students’ experiences during two different periods (teacher-centered and inquiry-based) and to explore how experience-sampling data could be used to describe students’ experiences during the inquiry-based period.

The results indicated that the students’ studying experiences differed during the two periods. Negative affects (stress, irritation, nervousness, anxiety) in study situations were higher during the inquiry-based period than the teacher-centered period. Further, the students reported being challenged more while studying during the inquiry-based period. On the other hand, the interviews showed a more diverse picture of the emotional experiences. The students reported both positive and negative emotional experiences, along with those of being challenged, and all of these mostly related to collaboration and co-regulating the learning process.

Methodological reflections

Experience-sampling data, such as those presented in this study, are rich and multidimensional in nature. We observed nine students only, and extensive conclusions cannot be made on the basis of these results. Still, the sampling of the target group was almost complete, and therefore reliably reflects the participants’ experiences. The analyses were robust, but the MANOVA in particular probably masks some aspects of the participants’ experiences. The study compared group means to show experiential differences during the two periods. Using a larger sample and other methods might reveal additional, subtler aspects of students’ experiences.
No differences were observed between the two periods when the students were not studying. This implies that the differences were indeed study-related, and not a result of something concerning the methodology, i.e. a change in answering tendency. If the affects would have been higher during the inquiry-based period while the participants were not studying, it might have meant that the study period would have been too stressful and that the stress would also spread into the participants’ free time. Altogether, on the basis of these results, it can be concluded that the study situations during the inquiry-based period gave rise to more challenges and negative affects.

The two follow-up periods were one year apart. During this time the participants had moved on from their first year at university to the second and had most likely matured academically, which probably also influenced how the learning process was perceived. This might have had an impact on the results of the study. However, because the questionnaires were comprised of items focusing on how the situation was perceived at the time and not on retrospective generalizations, the comparison of the differences between the two periods should be reliable. When interpreting the results one must remember that if the two follow-up periods had been successive, the results might have looked different.

It is interesting that the CASS-data and the interviews convey a somewhat different picture of the students’ experiences during the inquiry-based period. While the CASS data revealed students experiencing stress and challenge, the interviews presented descriptions of rewarding experiences. It is also possible that the methods used did not capture certain aspects of experiences. For example, when both challenge and competence are high, students are often oscillating between experiences of flow and anxiety. The analyses used here provided no opportunities to make this visible.
Implications for education

On the basis of the interviews, it appears that the students enjoyed the project despite the learning situations being demanding. The descriptions of both positive and negative emotional experiences related to autonomy and collaboration. Järvenoja & Järvelä (2009) found that these are the most important aspects producing socio-emotional challenges in collaborative work. On the other hand, Tsai et al. (2008) found that they are also key elements in how interesting a study situation is felt to be. Thus it appears that the same elements that spark excitement in collaboration also increase frustration.

Challenging and emotion-provoking situations are likely to capture a learner’s attention (Moneta & Csikszentmihalyi 1999; Pekrun 2005). The students did experience higher levels of negative affects and challenge during the inquiry-based period. Therefore, it can be assumed that the learning environment during the period was probably effective in focusing learners’ attention. However, while some amount of stress is needed for focusing attention effectively, excessive stress leads to a loss of concentration (Kember & Leung 2006). It is probable that stressful experiences alone are likely to decrease motivation. Consequently, sufficient scaffolding should be offered to students in learning environments where a great deal of responsibility is given to the students (Vermunt & Verloop 1999). The challenges were found to relate mostly to adopting a novel way of working and organizing the collaborative work. These are elements that can and should be supported by teachers when students are introduced to collaborative studying. In this study, the participants did report relying on their teachers and receiving help when in need of it. Further studies might reveal whether among such students the group itself functions as a scaffold for handling challenging tasks.
According to Vermunt and Verloop (1999), constructive friction stimulates students to increase their skills in learning and thinking strategies. The learning environment during the inquiry-based period presented challenges, and this may have caused stress for the participants. Yet in the interviews, the students also emphasized greatly appreciating the learning experience. On the basis of this, it may be the case that even constructive friction causes anxiety and other negative affects. Lindblom-Ylänne and Lonka (1999; 2000) showed how the dynamic interplay between the learner and the learning environment constantly changes, and generates a variety of frictions in which the level of engagement appears vary according to students’ approaches to the learning situation and how the learning environment is organized.

When students enter a new learning environment they face new challenges. They do not necessarily perceive what is required of them and must look for new learning strategies. The experiences of challenge and negative affects reported by the subjects in this study reflect the difficulties faced in new situations. If sufficient support is absent, there is a danger of students drawing on essentially impractical survival strategies such as surface-level learning. In a longitudinal study examining an entire Master’s program Lonka and Ahola (1995) described how students exposed to activating methods studied more slowly during the first three years, but were more successful in the long term when compared to students in a more traditional learning environments. Learning to be an active learner is a long process, and conclusions cannot be drawn solely on the basis of a single course.

While in a teacher-centered setting the teacher has the possibility to predefine tasks to match the students’ skills, this becomes more complicated in an inquiry-based setting. Inquiry-based settings also differ in their level of structure
and in the nature of the question pursued. It has been argued that open-inquiry settings produce the most favorable environment for learning and acquiring research skills (Sponken-Smith & Walker 2010). However, there is a danger of the students finding their tasks too challenging, which may lead to frustration and loss of interest. A gradual scaffolding of the learning process by the teacher is essential to ensure that the friction caused by the challenges does not become too great for the students.

The same stressful Tuesday that emerged during the study can clearly be seen as a negative experience from the students’ point of view. The contextual CASS data showed a peak in negative affects, and the interviews presented descriptions of frustration and challenge in the learning situation. The CASS data also showed a clear distinction between experiences of low competence and high challenge. According to flow theory, such a state represents anxiety (Csikszentmihalyi 1988). In contrast, the optimal working situation would be one in which students experience both challenge and competence to a high degree. However, in flow theory these states are defined and studied exclusively in terms of individual experiences. Focusing on contextual experiences in social situations could thus shed light on the social nature of emotions and flow.

**Suggestions for Further Research**

Experience-sampling methods have usually been presented as an effective means of analyzing events on an individual, within-person level (Bolger et al. 2003). Nevertheless, on the basis of this study, we suggest that the methods can also offer interesting opportunities for analyzing the nature of social experiences and motivation in group work. The study focused on experiences at the group level, but as Järvelä et al. (2010) emphasize, both individual and social processes should be combined in order to better understand the motivational
aspects of collaborative learning. Experience-sampling is a promising method for these purposes, but in this study a larger sample would had been needed to analyze individual processes. We propose that quantitative and qualitative data should be used in tandem to grasp the multidimensional nature of collaboration. Using only one of these conceals important aspects of the process.

Relevant questions remain. The first is, why the students experienced their study tasks as more challenging during the inquiry-based period. Analyzing the students’ web discussions could reveal what kinds of tasks they were engaged in. The second question concerns the students’ experiences during the inquiry-based period. With the CASS-methodology, we were able to derive one obvious negative experience from the data, but the students also reported having many positive experiences. What characterizes these situations? It is important to use the collected data to explore the qualities of positive learning experiences. Focusing on stressful experiences alone is of little help in developing pedagogical practices.

The final and most important question is methodological in nature. How this type of data could be utilized more effectively in analyzing the elements of successful studying and group work? Although methodologically challenging, focusing on students’ experiences in authentic learning situations may open fascinating opportunities for educational research. It is also a promising approach, in that it could shed light on why some educational experiments contribute to successful learning and others do not.

**Acknowledgements**

This study has been financed by the Academy of Finland (project number 116847). We are thankful for the support we have received. The CASS methodology used in the study was developed in the Knowledge Practices Laboratory (KP-Lab), a research project funded by the EU.
The paper is one of research group’s many collaborative research efforts. The group is led by professors Kirsti Lonka, Kai Hakkarainen, and Katariina Salmela-Aro. We are grateful for the valuable work done by the other members in our research group: Hanni Muukkonen, Annamari Heikkilä, Kari Kosonen and Satu Jalonen. We also thank to Sofie Loyens for her insightful comments.
References


Table 1. Number of observations during the two periods.

<table>
<thead>
<tr>
<th>Participant’s study-status</th>
<th>Lecture</th>
<th>Inquiry-based</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Studying</td>
<td>106/18.4%</td>
<td>136/23.7 %</td>
<td>242/42.1 %</td>
</tr>
<tr>
<td>Not-studying</td>
<td>187/32.5 %</td>
<td>146/25.4 %</td>
<td>333/57.9 %</td>
</tr>
<tr>
<td>Total</td>
<td>293/51.0 %</td>
<td>282/49.0 %</td>
<td>575/100 %</td>
</tr>
</tbody>
</table>
Figure 1. Positive affects (PA) and negative affects (NA) during the two follow-up periods while studying and not studying (95% confidence limits)

Figure 2. Importance, challenge and competence during the two follow-up periods while studying and not studying (95% confidence limits)
Figure 3. Participants’ (N=9) positive and negative affects during the two-week follow-up (z-points)
Figure 4. Participants’ (N=9) experiences of competence and being challenged, during the two-week follow-up (z-points)