CASS-methods and tools for investigating higher education knowledge practices

Hanni Muukkonen, Department of Psychology, University of Helsinki P.O.
Box 9 FIN-00014, Finland, hanni.muukkonen@helsinki.fi
Kai Hakkarainen, Department of Education, University of Helsinki P.O.
Box 9 FIN-00014, Finland, kai.hakkarainen@helsinki.fi
Mikko Inkinen, Kirsti Lonka, Department of Applied Sciences of Education,
University of Helsinki , P.O. Box 9 FIN-00014, Finland, mikko.inkinen@helsinki.fi
Katariina Salmela-Aro, Department of Psychology, University of Jyväskylä
P.O. Box 35 FIN-40014, Finland, katariina.salmela-aro@psyka.jyu.fi

Abstract: The Contextual Activity Sampling System (CASS) research methodology and the CASS-Query mobile application have been developed for contextually tracking of participants' object-oriented activities. The method relies on Ecological Momentary Assessment designed to trace real-time advancement of learning activities by frequent sampling during periods of intensive follow-up. The paper presents a subset of findings from the first year data-collection from five groups of students, regarding their knowledge practices while studying in a higher education context. The study reports affects, challenge, competence, and commitment, together with the information about interaction and context, collected using mobile phones in an intensive two-week follow-up period. Results revealed that different contexts were associated with variable combinations of challenge and competence. Further, studying in a library and a small group were related to the highest ratings of optimal experience and commitment.

Investigating academic knowledge practices

The purpose of the present article is to introduce process-sensitive and contextual methodology for studying epistemic practices characteristic of academic learning. The study is a part of Knowledge-Practices Laboratory project (KP-Lab, http://www.kp-lab.org) that is focused on facilitating innovative practices of working with knowledge in polytechnics and universities. In the background of the project are the three metaphors of learning, i.e., the knowledge-acquisition metaphor, participation metaphor, and knowledge-creation metaphor (Paavola, Lipponen, & Hakkarainen, 2004; Paavola & Hakkarainen, 2005). We consider the metaphors as heuristic tools that assist in examining various aspects of learning. We propose that in learning there are always three aspects of human activity involved, i.e., subjective (individual learning and cognition), intersubjective (social communities and cultural interpretations), and objective (material culture and designed entities) represented by the three metaphors (compare Davidson, 2001). While the first two have been extensively examined and investigated, the third aspect is mostly unknown territory. In order to have a holistic view of learning, the present investigation is focused on developing rigorous methods for examining learning, in a coordinated way, using all three metaphors of learning.

This research relies on an assumption that learning is a by-product of taking part in social practice: it is not reducible to beliefs or other individual mental processes (Marton & Triggwell, 2000). We argue that collectively cultivated knowledge practices, far more than personal dispositions or beliefs, determine the nature of learning. By 'knowledge practices' we mean social practices related to working with knowledge, i.e., personal, collaborative, and institutional routines; these include repeated procedures for carrying out learning tasks, solving problems, completing assignments, and creating epistemic artifacts, such as essays and research reports. KP-Lab project is focused on promoting practices that a) capitalize on epistemic mediation (i.e., mediation through creating epistemic artefacts) and b) cross-fertilize knowledge practices between academic and professional communities by engaging students in solving problems coming from professional communities. A knowledge practice perspective implies investigations that focus on examining the processes of creating and advancing knowledge across relatively long periods of time. In order to deal with the amount and complexity of data collected, it appears essential to sample the unfolding activity process in one way or another. In the present case, we carried out the sampling by having a yearly two-week follow-up period during which we collected very detailed information of the participants' knowledge practices.

The *Contextual Activity Sampling System* (CASS) being developed by the present investigators is intended to provide generalizable tools for studying knowledge practices in context, in conjunction with ethnographic methods of investigation. The research instrument being developed relies on Experience-Sampling Method (ESM, Csikszentmihalyi & Larson, 1987; Csikszentmihalyi, 1996) and Ecological Momentary Assessment (EMA, Bolger, Davis, & Rafaeli, 2003; Reis & Gable, 2000; Stone & Shiffman, 2002), which

provide methods of assessing participants' contextual activities, events, and personal experiences. Traditional survey methods are usually individually oriented and focus on the participants' beliefs and other discursive entities rather than their practices as they occur. Such methods provide a frozen picture of students' behavior rather than address learning processes occurring in their cultural context. A student may be asked, for instance, to assess how he or she prepares for examinations (in general). The central weakness of this approach is that the participants are asked to provide retrospective global assessments (Reis & Gable, 2000) of their beliefs and conceptions of learning rather than measure learning activity unfolding in real time. When measures are conducted only once, the most important source of variance is between participants; data analyses are, consequently, focused on examining individual or group differences. An essential aspect of methods related to ESM and EMA is to provide a large number of measures (50-60 per participant) regarding learning activities across situations and contexts during periods of intensive follow-up. Longitudinally oriented investigations involving variance between contexts (e.g., lecture, small group, field, or leisure) allow investigators to examine patterns of evolving activities. Contrary to survey methods, generalizations are made by researchers by aggregating observations or modelling changes across time by relying on time-series analysis or linear growth models.

We are currently exploring various ways of sampling the participants' knowledge practices. In the present CASS, *fixed-interval sampling* suitable for time-series analysis is complemented by studies based on *event-contingent sampling* (i.e., occurrence of critical incidents). Moreover, structured, open-ended, textual, and audio responses are being used in the ongoing investigations. An essential aspect of the present investigation is to examine the objects of the participants' activity across the periods of intensive follow-up through pre- and post-investigation interviews, daily probing, and moment-to-moment tracking. Further, in-depth learning presupposes strong motivation, engagement, self-efficacy, and flow; these socio-emotional factors of epistemic activity often play a critical role in the occurrence and overcoming of learning difficulties. Consequently, it is essential to collect data about academic emotions taking place in learning processes. It appears that one truly cannot examine knowledge practices without addressing motivational and socio-emotional aspects of activity. As far as learning is concerned, reason and emotion appear to be intrinsically connected.

Academic emotions

Prior research on academic emotions has examined various affects during studies (for review, see Pekrun, Goetz, Titz, & Perry, 2002); generally, they utilize stimulated recall or interview methods asking participants to report emotions in the prior situations to study academic emotions (Pekrun, 1992). Relying on experience-sampling methods, the research on flow (Csikszentmihalyi, 1995; Delle Fave & Massimini, 2005) has highlighted the interdependencies of competence and challenge in defining the basic types of experiences, ranging over optimal experiences and those of relaxation, anxiety, and apathy. Among these, *optimal* experiences are characterized by high challenge combined with adequate competency for the task or situation. It is supported by high concentration, engagement, and control of the situation, which render such experiences rewarding. For *relaxation* experience, feelings of competence are heightened while challenge is low. For *anxiety* experience, the opposite combination is prevalent; a high challenge is perceived while competence is considered low. For *apathy* experience, both challenge and competence are low, and its occurrence has been associated with feelings of a lack of attention, concentration, and control. Furthermore, it has been suggested by Della Fave and Massimini (2005) that the positive psychological features of optimal experience have long-term effects on development; optimal experiences create a positive circle of enjoying the situation and looking for suitable challenges, which recreate such feelings in the future. This, in turn, cultivates the necessary skills. In their study, only individual learning activities were selected to be included in the analysis of participating college students. However, in light of investigating social practices, in our study it was deemed central to focus on different types of educational contexts and both individual and collaborative activities.

Times of transition between secondary education to tertiary education and again from studies to work life are intriguing, but not very well-known periods in students' lives. Novel contexts set new requirements for students in subjective, intersubjective, and object-oriented activities. An individual's success in dealing with a transition has been suggested to dependent on the level of interest in the goals that focus on the transition, belief in one's ability to attain those goals and required strategies for achieving them, as well as positive emotions toward the transition (Nurmi, Salmela-Aro, & Koivisto, 2002).

The role of contextual factors has been well described in the paradox of failure by Perry, Hladkyj, Pekrun, and Pelletier (2001). The paradox of failure relates to the transition from high school to college and a frequent phenomenon that bright, highly successful high school students fail once they reach college, apparently overwhelmed by the demands for self-initiative and autonomy of the novel academic context. For curriculum designers and university teachers, this poses a challenge for matching task demands to capabilities (Pekrun, 2006) and providing sufficient tutoring and scaffolding during the first year. For students, there are numerous other challenges also involved: creating new social networks, building up one's own knowledge and skills, as well as socializing into the knowledge practices of an academic environment.

One aspect of knowledge practices is the role of commitment during studying. In prior studies, the role of commitment has been studied in relation to goal attainment and commitment to team goals (e.g., Aubé & Rousseau, 2005; Lee, Carswell & Allen, 2000), suggesting that commitment is positively linked to performance both measured as an individual's and a team's outcome. However, there is not much knowledge about the context-bound changes in commitment for university students.

Research questions

The purpose of the CASS studies is to elicit analysis of the actual studying and working practices of higher education students, and to determine what kinds of socio-emotional and flow experiences are associated with and motivate their efforts, and elicit trialogical knowledge practices and the development of epistemic agency. The study is planned to include intensive 3-4-year follow-ups with the same students. To repeat the data-collection during four consecutive years, the students are asked yearly to take part in a two-week intensive data collection, questions prompted by mobile telephone five times a day (e.g., Nokia E70).

Central in the methodological development work has been the intent to integrate quantitative and qualitative data-collection and analysis means. This choice is motivated by an aspiration to arrive at a triangulation of findings to present the examined knowledge practices holistically. Furthermore, a longitudinal follow-up is required to achieve this; following the first-year students is the first step in this process. To summarize, we have used data from the personal queries and interviews, and degree program information. The well-known weakness of collecting data by self-reports is that self-reports may be subject to response biases. However, gathering data from each participant on nearly 60 sessions enables the analysis of these biases, as they become evident.

In this paper, the research questions addressed are as follows:

- Are there differences by degree program regarding time spent in individual and group working the follow-up period?
- How does context (location) during studying relate to feelings of challenge, competence, and commitment?
- Does this method enable one to investigate knowledge practices in context? What kinds of limitations are encountered?

Method

Participants

During the spring 2007, four two-week CASS-mobile phone research periods took place. Participating students (N = 55) were in their first year of studies. At the University of Helsinki, there were two groups participating, educational psychology (n = 9) and teacher training (n = 6). At the University of Jyväskylä they were participants majoring in psychology (n = 20). In Espoo, student were engineering students from the EVTEK University of Applied Sciences, media engineering in the Finnish degree program (n = 13) and in the English degree program (n = 7). The mean age for students was 22.3 years (SD = 3.1), ranging between 19 and 37 years of age.

The five degree programs had some basic differences in their curriculum structures. Particular to the educational psychology group was that they study intensively as a small group of ten students throughout their first three years. The teacher training group studies in the same campus, but their tuition is generally lectures during the first year. For the psychology group, their curriculum consists of courses provided as lectures during the first year. The two engineering groups study in the same campus. The participants in the Finnish degree program represent a more homogenous cultural background, while the participants in the English degree program have a multinational cultural background. However, for both groups, first year courses are conducted mostly in large lectures, but also require some project work for which small groups are created.

Data collection and analysis

The mobile phones were preset to set off an alarm signal for the participants every three hours to open the application, e.g., at 8 and 11 AM and 2, 5 and 8 PM. The CASS-Query application then connected the server database and retrieved the intended questionnaire. After answering the query questions, students saved the data, which automatically returned the data to the database. Participants considered the application very easy to use. A personalized alarm schedule was tailored for each student, depending on their preferences for starting their morning work (between 7 and 10 AM).

During the data-collection period, the students were asked to answer five queries each day. In this study, we will particularly report findings from the following subset of query questions. We asked the students to report in every query their present activities by answering to an open ended question: 'What are you doing right now?' In the next questions, they were asked to rate (Likert scale 1-7) their feelings of challenge ('How challenging is this for you?'), competence ('How competent do you feel?'), and commitment ('How committed

are you?') directly related to this 'doing'. Further, they were asked to report 'Where are you right now?' by selecting one of the predefined choices of location, and finally, 'Are you interacting with someone else?' where answering 'no' concluded the query and answering 'yes' prompted a question of 'With whom?'.
Other examples of issues addressed were:

- Objects of activity (things they were doing and personal projects defined as exams, courses, learning of skills, hobbies, and other interests)
- Self-efficacy and flow (e.g., How absorbed are you in what you do?)
- Stress (Do you feel stress?, see Elo, Leppänen, & Jahkola, 2003)
- Affects (PANAS scales, e.g., enthusiastic, nervous, see Watson, Clark, & Tellegen, 1988)
- Obstacles and constraints (What hampers or restrains your activities?)

The morning questionnaire also contained planning questions about most important things participants were about to do on that day. The evening questionnaire contained reflective questions about the things they had done. Altogether, we collected 3376 observations about feelings of which 2042 contained context information. In addition, we got about 1400 planning and reflecting answers. Data from 55 participants were included in the analysis; three cases were excluded due to missing data.

The students were also interviewed individually before and after the two-week period and information was collected about their curriculum, which courses they were taking part in and how those courses were organized. For each student, we have descriptions of four projects that they presented as central in the examined period.

Results

Preliminary results showed us that there were significant differences between the five groups of students investigated regarding study practices in the first year. Two groups of students had particularly high proportion (over 70 %) of interaction while working; the small group of educational psychology students at UH, 72 percent, and the Finnish degree engineering students at EVTEK (Engineering-F), 73 percent. In contrast, the psychology students at University of Jyväskylä reported working, 67 percent of the time on their own (see Figure 1). In the two engineering groups the students in the English degree program spend in comparison more time studying on their own. Between the two UH groups a difference was also observed, and the fact that the educational psychology group does all their specific degree courses in their own small group is also evident from the distributions in their self-reports. Further, a more qualitative analysis has yielded preliminary findings comparing the two degree programs in UH and in EVTEK suggesting that the arrangements where students were working more in small groups were fruitful in building a learning community.

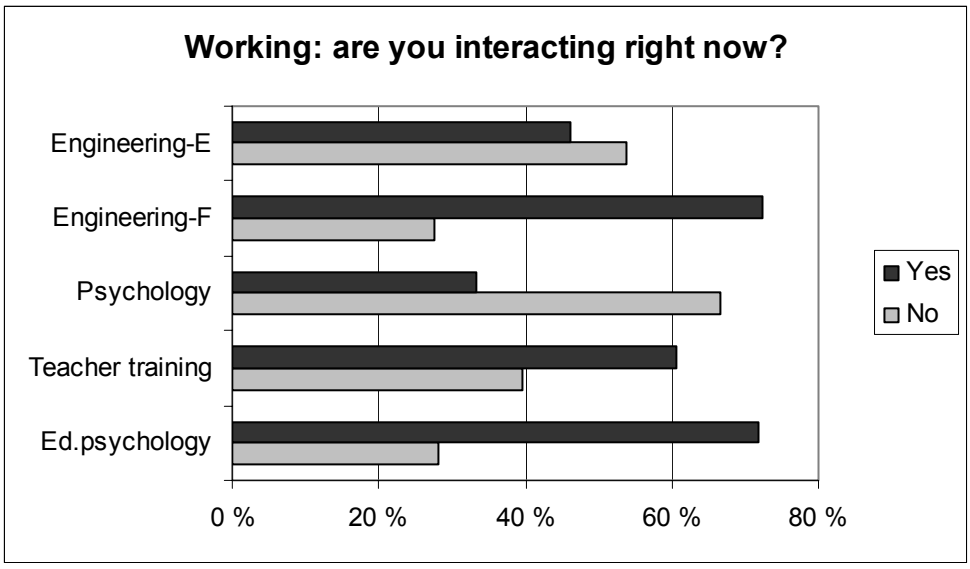

Figure 1. Self-reported interaction while working or studying.

In Figure 2, the relationship of challenge and competence is compared to the location. For each student, an average for challenge and competence was calculated, and further, the averages were used to create a measure of above (high) and below average (low) challenge and competence. Four combinations (e.g., low challenge and low competence) were then mapped against the reported working or studying related contexts: cafe, lecture, library, and small group. Typical for a cafe was that students reported low challenge but high competence (relaxation) compared to their average values. At lecture, the proportion of high challenge with low

competence grew larger (anxiety). At library, high challenge with high or low competence were most frequent (anxiety or optimal). In small group activities, high challenge with high competence became more prevalent suggesting more frequent flow feelings (optimal) in these situations. It is also worth noticing that at the library or in a small group students hardly felt any low challenge and low competence (apathy). Overall, we found a significant effect for the location $\chi 2$ (9, N = 526) = 100.6, p < .0001.

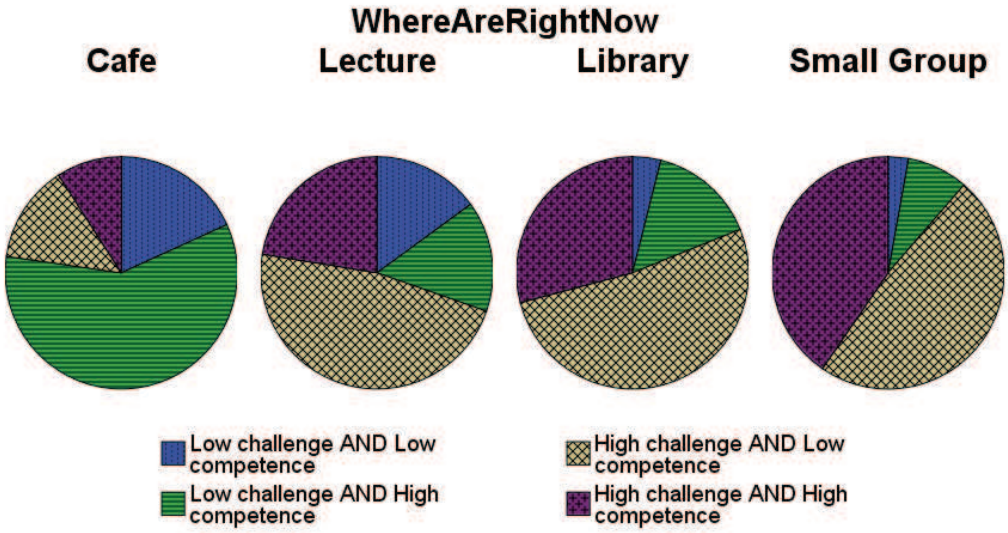

Figure 2. Location in relation to ratings of challenge and competence.

From affect variables (Likert scale 1-7, with 7 representing highest value), two sum variables were composed. The positive feelings sum involved determined, interested, enthusiastic, and energetic (n = 3350, Cronbach's Alpha = 0.87) and the negative feelings sum consisted of nervousness, irritated, anxious, and stress (n = 3356, Cronbach's Alpha = 0.83). These sum variables were scaled so that the population average was zero and the standard deviation one and then mapped together with the commitment reported by participants (Likert scale 1-7, with 7 representing highest commitment). The findings revealed that positive feelings increased as the level of commitment rose. Negative feelings, on the contrary, showed a small decline as the level of commitment rose. With a low commitment, negative feelings were dominant, while with high commitment positive feelings became dominant. With a medium commitment negative and positive affects did not differ markedly (see Figure 3).

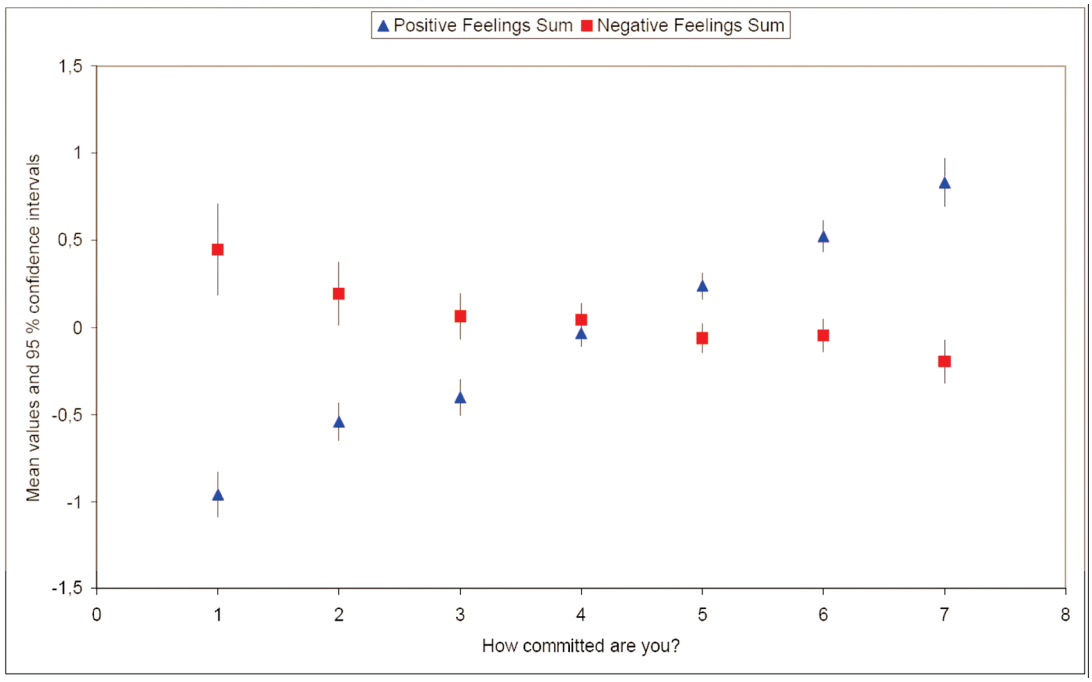

Figure 3. Affects and commitment while studying.

Comparing location (cafe, library, lecture, and small group) and commitment showed that the average level of commitment was highest in the library, small group, and cafe (see Figure 4). In lecture, students reported the lowest commitment. Overall, we found a significant effect for the location (one way ANOVA, $p < .00001$).

The CASS data-collection captured, with staggering detail, students' self-reported doings during this two-week period. Students' study related activities appeared to be quite scattered under many smaller, course-related objects. As expected, students often reported that they were taking part in a lecture, studying to pass a certain course, or completing exercises. Another type of central activity was being part of a dialogical interaction, e.g., during group work, lunch, or coffee break. A third type of activity was leisure-related doings, such as sports, hobbies, or relaxation at home. A knowledge creation type of object-oriented activity was, however, rarely reported connected to studying: the few cases we identified of such type of activity were connected to engagement in leisure, e.g., recording a demo CD or preparing materials for some civic organization.

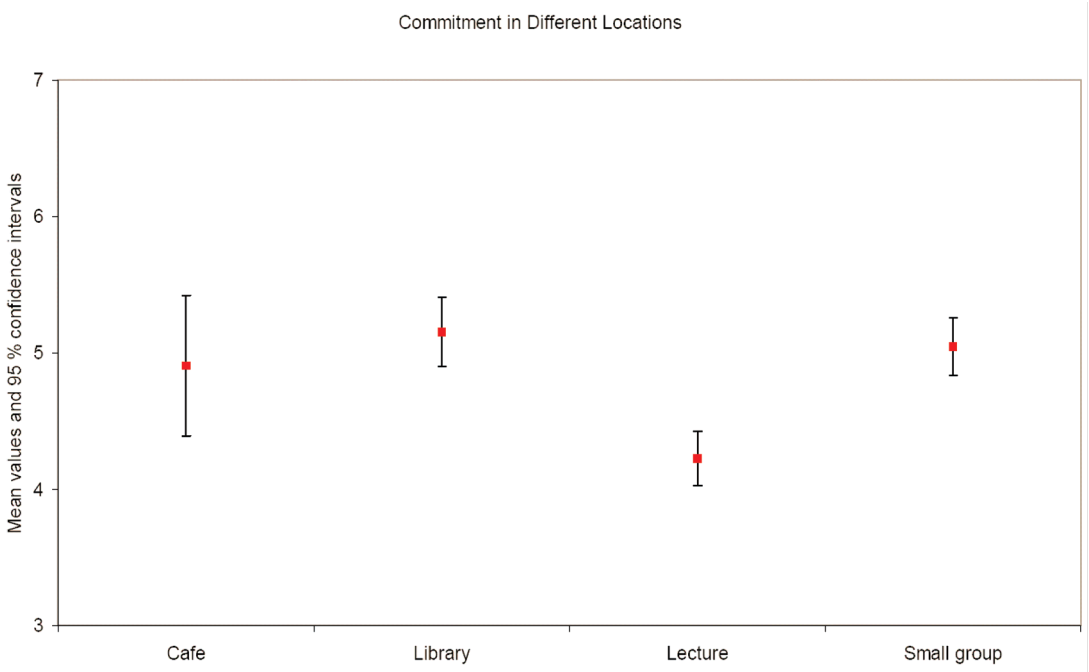

Figure 4. Location and commitment while studying.

Conclusions

The present study reported preliminary findings from a two-week intensive follow-up of higher education students' knowledge practices. Within the three studied institutions, the students reported markedly different patterns of engagement in collaboration in the five degree programs, suggesting that the design of the curriculum may have a major impact on whether students end up working solo (more lectures and exams) or with peers (more projects and collaborative assignments).

As the reported context was examined in connection with feelings of challenge and competence, the most optimal feelings were connected with working in the library or a small group. A contrasting finding became evident for lectures, as it was more often related to high challenge with low competence. Cafe was an important location for relaxation and feeling competent. Examination of commitment in these locations during studying or working showed that the average level of commitment was highest in the library, small group, and cafe. Further, with a low commitment, negative feelings were dominant, while with a high commitment positive feelings became dominant. Overall, in the follow-up period for these first year students, it appears that lectures were the least motivating environment. As lectures are the type of tuition most often offered to first-year students, this finding deserves further considerations both in respect of curriculum design and research on pedagogical practices. However, we have not addressed, thus far, issues of knowledge gain, and therefore these findings should be understood as descriptive of students' appraisals of their own motivation and knowledge practices.

At present, the CASS tools and methods are under development. The present design of data-collection provided us with valuable understanding on the possibilities and limitations of data-collection by mobile phones. Using the phones and the application was easy for the participants. More difficulties were presented in devising the questions so that they would be understandable and valid for most situations in the follow-up period. Here

we encountered difficulties with the three participants excluded from the analysis due to missing data. As presented already in the introduction, next efforts will be directed towards employing event-contingent sampling, focusing particularly on social practices related to working with knowledge and creating epistemic artifacts. The fixed-interval sampling provided us a required baseline for further comparisons, but was not, apparently, as descriptive for the object-oriented activities as we had hoped. Naturally, we need to consider whether first year students' knowledge practices should be expected, in general, to reflect practices of knowledge creation. Alternatively, a) our methods may not have captured them, b) knowledge creation might be more frequent during leisure activities, which relate to long-term interests and hobbies, or c) they will emerge as studies progress. Further research is required on these questions.

In the background of the present project is "The emergence of epistemic agency in academic education" project funded by the Academy of Finland. Within the frames of this project, the CASS methods are being validated by intensively collecting data (regular interviews, study logs, videotaped ethnographic participation observations) of daily epistemic practices of educational-psychology students of the University of Helsinki. The study is based on a longitudinal design; by collecting data of the participants' first-year knowledge practices, we aim at establishing a baseline concerning their academic knowledge practices – during the following three years, we will collect repeated measurement data, which, we hope, will reveal the practices involving systemic efforts of developing shared knowledge taking place in extended network of students, lectures, and external experts.

References

Aubé, C., & Rousseau, V. (2005). Team goal commitment and team effectiveness: The role of task interdependence and supportive behaviors. *Group Dynamics: Theory, Research, and Practice, 9*, 189–204.

Bolger, N., Davis, A., & Rafaeli, E. (2003). Diary methods: Capturing life as it is lived. *Annual Review of Psychology, 54*, 579-616.

Csikszentmihalyi, M., & Larson, R. (1987). Validity and reliability of the experience-sampling method. *The Journal of the Nervous and Mental Disease, 175*, 526-536.

Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. New York: HarperPerennial.

Davidson, D. (2001). Subjective, intersubjective, objective. Oxford: Oxford University Press.

Delle Fave, A., & Massimo, F. (2005). The investigation of optimal experience and apathy: Developmental and psychosocial implications. *European Psychologist, 10*, 264-274.

Elo, A-L., Leppänen, A., & Jahkola, A. (2003). Validity of a single-item measure of stress symptoms. *Scandinavian Journal of Work Environment Health, 29*, 444–451.

Lee, K., Carswell, J.J., & Allen, N.J. (2000). A meta-analytic review of occupational commitment: Relations with person- and work-related variables. *Journal of Applied Psychology, 85*, 799-811.

Marton, F., & Trigwell, K. (2000). Variatio est mater studiorum. *Higher Education Research, 19*, 380-395.

Nurmi, J-E, Salmela-Aro, K., & Koivisto, P. (2002). Goal importance and related achievement beliefs and emotions during the transition from vocational school to work: Antecedents and consequences. *Journal of Vocational Behavior, 60*, 241–261.

Paavola, S., Lipponen, L., & Hakkarainen, K. (2004). Models of Innovative Knowledge Communities and three metaphors of learning. *Review of Educational Research, 74*, 557-576.

Paavola, S., & Hakkarainen, K. (2005). The Knowledge Creation Metaphor – An emergent epistemological approach to learning. *Science & Education, 14*, 535-557.

Pekrun, R. (1992). The impact of emotions on learning and achievement: Towards a theory of cognitive/motivational mediators. *Applied Psychology, 41*, 359–376.

Pekrun, R., Goetz, T., Titz, W., & Perry, R.P. (2002). Academic emotions in students' self-regulated learning and achievement: A program of quantitative and qualitative research. *Educational Psychologist, 37*, 91-106.

Pekrun, R. (2006). The Control-Value Theory of Achievement Emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review, 18*, 315-341.

Perry, R.P., Hladkyj, S., Pekrun, R.H., & Pelletier, S.T. (2001). Academic control and action control in the achievement of college students: A longitudinal study. *Journal of Educational Psychology, 93*, 776-789.

Reis, H.T., & Gable, S.L. (2000). Event sampling and other methods for studying daily experience. In H. T. Reis & C. Judd (Eds.), *Handbook of research methods in social and personality psychology* (pp. 190-222). New York: Cambridge University Press.

Stone, A.A., & Shiffman, S. (2002). Capturing momentary, self-report data: A proposal for reporting guidelines. *Annals of Behavioral Medicine, 24*, 236-243.

Watson, D., Clark, L.A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS Scales. *Journal of Personality and Social Psychology, 54*, 1063–1070.

Acknowledgments

The authors wish to acknowledge the importance of contributions from the entire CASS research and development team. The CASS-Query tool has been developed in the KP-Lab project (http://kp-lab.org). The KP-Lab Integrated Project is sponsored under the 6th EU Framework Programme for Research and Development. The authors are solely responsible for the content of this article. It does not represent the opinion of the KP-Lab consortium or the European Community, and the European Community is not responsible for any use that might be made of data appearing therein.