How learners share and construct metacognition in social interaction?

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Abstract: The aim of this exploratory study was to examine how the six matched triads of pre-service teachers share and construct metacognition in mathematical problem solving in WorkMates learning environment having or having not a stimulated recall group interview. More specifically, we examined *socially shared metacognition* and we performed the qualitative content analysis of the discussion forum data from metacognition point of view. The results showed metacognition becoming shared and metacognition becoming visible but not shared in discussions.

Theoretical background and aim

The aim of this exploratory was to examine how learners share and construct metacognition in social interaction. More specifically, we examined socially shared metacognition (e.g. Tindale & Kameda, 2000; Iiskala, Vauras & Lehtinen, 2004) by which we mean the phase in the groups' problem solving where jointly constructed knowledge is used to regulate and control the group's cognitive processes meaningfully for the group to reach joint solution. For this suggested being essential that an individual's computer note identified as metacognitive has an intention to interrupt, change or promote the joint problem solving process. The other members in the group are able to utilize the suggested way of thinking in their individual problem solving process.

For collaboration and joint problem solving it is essential that the participants make a conscious, continued effort to coordinate their activity in order to reach shared knowledge (Roshelle & Teasley, 1995). To do so, individual's need their metacognitions, referring to their knowledge of cognition, and regulation of cognitive processes (Flavell, 1979; Brown, 1987), to explicitly provide rationale for their own thinking and to verify their understanding about other participants' contributions to joint problem solving. Further, to construct the joint solution the group members have to contribute to the other participants' externalized knowledge by explicitly explaining their thinking (cf. Kirschner, Beers, Boshuizen & Gijselaers, 2007). In this process, the unshared knowledge in one participants' head becomes jointly constructed knowledge (Beers, Boshuizen, Kirschner & Gijselaers, 2005) through the negotiation of common ground (Bromme, 2000) where the participants make their own understanding explicitly visible and provide feedback for others by formulating their thoughts as written notes to the database (Lehtinen, 2003). Thus, the cognitively rich situation can be seen as a facilitator for reciprocal interaction and metacognition.

Method

Participants and working conditions

The participants in this study were 18 pre-service student teachers, aged 21 – 40 years at the beginning of their teacher studies at university. All of them were native Finns having their first course for teaching primary level mathematics. Almost 90% of them had graduated from upper secondary school during the years 2005 or 2004. The participants filled in two self-report questionnaires concerning metacognition in mathematical problem solving (modified, Howard, McGee, Shia & Hong, 2000) and group working skills, Students Appraisals of Group Assessment, SAGA (Volet, 1998). The items in the metacognition and mathematics problem solving questionnaire data were analyzed using the principal component analysis where the most powerful tendencies were liking or not liking mathematics and liking or not liking to work in groups. After the groups were matched, they were randomly assigned to two working conditions, *working in Workmates (WM) with or without stimulated recall group interview.*

In this study, they worked in triads and solved 16 mathematical problems during two hour sessions, four times during a four week period, January-February 2006 in university's computer classroom. Three groups had a stimulated recall group interview immediately after joint problem solving session and three groups did not have the interview. They worked with an asynchronous learning environment called Workmates (WM, http://wm.utu.fi). Each participant had a personal user account and password to login only to their own groups' folder.

Mathematical problems

The mathematical problems presented in this poster were the following:

Task 1. The equation problem

Find one pair of numbers that satisfies the following equation:

$$\left(\frac{3}{4}+x\right):5-4=y+\frac{1}{2}$$

Can you find another solution?
How many solutions you can find?

Task 2. A strict lecturer

A retired lecturer, known as a strict teacher, calculated how he, during his long and self-denying career had given marks to his students as follows: 26172 D's, 11 583 C's, 4884 B's and 955 A's. How many marks altogether did the strict lecturer give during his long and self-denying career to his students? How many percentages more had he given D's compared to A's?
In this task you are not allowed to use the calculator. You can use approximated values to calculate the percentages.

Data collection and analysis

The discussion forum data consists of the pre-service teachers' 624 computer notes. Further, the three triads' four video-recorded stimulated recall group interviews were transcribed and each interview lasted approximately 25 minutes. The stimulated recall interview data was used to augment the researchers' interpretation of the discussion forum data.

Discussion forum data

The pre-service teachers' written computer notes were analyzed from socially shared metacognition point of view, by two independent coders following the ideas of the qualitative content analysis (Chi, 1997). The unit of the analysis was one computer note. The rater independence coefficient, Cohen's Kappa was used (Cohen, 1960). In groups' problem solving metacognition was considered as socially shared when the group's groups' jointly constructed knowledge is used to regulate and control the group's cognitive processes meaningfully for the group to reach joint solution. The computer note was characterized as metacognitive if it fulfilled the following three criteria. First, the message should be related to and focused on the earlier or ongoing discussion at least implicitly. Secondly, the message should have an intention to interrupt, change or promote the progression of the joint problem solving process. Thirdly, the message should also have an explicit explanation as to why the group should take another feature of the problem into account. After the coding, two raters reached a satisfactory agreement (K=.78; Landis & Koch, 1977).

Results and conclusions

The results showed that the three dimensions of metacognition were identified in group problem solving; metacognition becoming shared, metacognition becoming visible but not shared, metacognition as an individual's attempt to regulate the joint problem solving. In case of metacognition becoming shared, there was a more knowledgeable peer in the group who regulated the group's problem solving which was appreciated by the others. The results also show that there were three groups in which there were some metacognitive messages during the joint problem solving although it was not acknowledged. This can be explained by the lack of group members' mathematical skills which prevented them from using and building on the proposed way of thinking.

The results suggest how for socially shared metacognition it is essential that the other participants make their (mis)understanding visible by explaining it explicitly to the others thus allowing the others in the group to regulate and control how shared knowledge is used in the problem solving process.

Selected references

Beers, P.J., Kirschner, P.A., Boshuizen, H.P.A. & Gijselaers, W.H. (2005). Coercing knowledge construction in collaborative learning environments. In T. Koschmann, D. Suthers & T-W. Chan (Eds.). *Computer Supported Collaborative Learning 2005: The Next 10 Years!* Proceedings of the International Conference on Computer Supported Collaborative Learning (pp. 8-17). Taipei, May 30–June 4, 2005.

Brown, A.L. (1987). Metacognition, executive control, self-regulation and other mysterious mechanisms. In F. Weinert & R. Kluwe (Eds.), *Metacognition, motivation and understanding* (pp. 65-115). Hillsdale, NJ: Lawrence Erlbaum.

Chi, M.T.H. (1997). Quantifying qualitative analysis of verbal data: A practical guide. *The Journal of the Learning Sciences, 6* (3), 271-315.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement, 20*, 37-46.

Flavell, J. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34*, 906-911.

Iiskala, T., Vauras, M. & Lehtinen, E. (2004). Socially-shared metacognition? *Hellenic Journal of Psychology 1*, 147-178.

Tindale, R. & Kameda, T. (2000). Social sharedness' as a unifying theme for information processing in groups. *Group Processes & Intergroup Relations, 3*, 123-140.