ELSEVIER

Learning and Instruction 21 (2011) 379–393

Learning and Instruction

www.elsevier.com/locate/learninstruc

Socially shared metacognition of dyads of pupils in collaborative mathematical problem-solving processes

Tuike Iiskala*, Marja Vauras, Erno Lehtinen, Pekka Salonen

Centre for Learning Research and Department of Teacher Education, University of Turku, Assistentinkatu 5, FIN-20014, Finland

Received 13 July 2009; revised 26 March 2010; accepted 9 May 2010

Abstract

This study investigated how metacognition appears as a socially shared phenomenon within collaborative mathematical word-problem solving processes of dyads of high-achieving pupils. Four dyads solved problems of different difficulty levels. The pupils were 10 years old. The problem-solving activities were videotaped and transcribed in terms of verbal and nonverbal behaviours as well as of turns taken in communication ($N = 14\,675$). Episodes of socially shared metacognition were identified and their function and focus analysed. There were significantly more and longer episodes of socially shared metacognition in difficult as compared to moderately difficult and easy problems. Their function was to facilitate or inhibit activities and their focus was on the situation model of the problem or on mathematical operations. Metacognitive experiences were found to trigger socially shared metacognition.

Keywords: Socially shared metacognition; Shared regulation; Metacognitive experiences; Collaborative processes; Mathematical problem solving

1. Introduction

This article aims to contribute to the still scarce evidence available on the social nature of metacognitive regulation of joint efforts in a collaborative problem-solving process, and to offer systematic means to operationalise and analyse shared regulation. The need and the rationale for studying social regulation are based on the view that the group is a social system (Vauras, Salonen, & Kinnunen, 2008), a qualitatively different entity from individuals working side by side, but on their own (Salomon & Globerson, 1989). Social regulation cannot be reduced to the group members' individual characteristics such as self-regulatory activities, rather inter-relational characteristics and functioning are needed in order to understand group dynamics as a complex situational interplay across different systemic levels (Volet, Vauras, & Salonen, 2009). Both the self and social forms of regulation (other- and co-regulation) are needed in order to understand regulation of actual collaborative learning processes. In other words, the manifestation of inter-individual metacognition is not equivalent to individual metacognition, and should be conceptualised differently (Iiskala, Vauras, & Lehtinen, 2004; Vauras, Iiskala, Kajamies, Kinnunen, & Lehtinen, 2003). In addition to the generic term "co-regulation" (McCaslin, 2009; Volet, Summers, & Thurman, 2009; Volet, Vauras, et al., 2009), we have introduced the concept "socially shared metacognition" (or "shared regulation") to refer to the consensual monitoring and regulation of joint cognitive processes in demanding collaborative problem-solving situations (Iiskala et al., 2004; Vauras et al., 2003). Socially shared metacognition can be considered the most profound social mode of regulation, because it refers to individuals' metacognitive processes that operate as a genuine social entity, aimed at a single objective, that is, the fully shared goal of the activity (Volet, Vauras, et al., 2009).

However, despite growing agreement on understanding regulation as both an individual and a social process (see, e.g.,

* Corresponding author. Tel.: +358 2 333 6937; fax: +358 2 333 8800.
E-mail addresses: tuike.iiskala@utu.fi (T. Iiskala), marja.vauras@utu.fi (M. Vauras), erno.lehtinen@utu.fi (E. Lehtinen), pekka.salonen@utu.fi (P. Salonen).

0959-4752/$ - see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.learninstruc.2010.05.002

McCaslin, 2009; Nolen & Ward, 2008; Volet, Vauras, et al., 2009), empirical evidence on social regulatory processes pertaining to higher order learning is scarce and insufficient compared to the extensive conceptual analyses and empirical studies on individual metacognition for more than 30 years, starting from the seminal work of John Flavell and Ann Brown in the 1970s and 1980s (Brown, 1978, 1987; Flavell, 1976). In these studies, sophisticated operationalisations and methods to study individual metacognition have been introduced. However, the study of metacognition as a social phenomenon is characterised by a lack of clear operationalisation and methods of data analysis. The case studies of Iiskala et al. (2004) and Vauras et al. (2003) have clearly demonstrated that it is possible to distinguish social regulation processes from individual ones in collaborative learning contexts. To understand the functions and fluctuations of self- and social regulation in collaborative contexts, reliable methods to identify and analyse socially shared metacognition within large data sets of interactions are urgently needed. The main aim of the present study was to investigate whether and how this can be done, and to present a detailed analysis of the functions and foci of socially shared metacognition. This was studied by analysing high-achieving dyads' collaborative mathematical problem-solving processes.

1.1. Shifting from individual to social processes in metacognition research

Metacognition has traditionally been understood as a person's own knowledge about cognition and the regulation of cognitive processes (Brown, 1978, 1987; Flavell, 1976). Although the focus has been on an individual's learning, early metacognition studies already referred to social aspects such as social interaction, social context, communication and role-taking as facilitators of metacognition (Brown, 1978; Brown & Palincsar, 1989; Flavell, 1976, 1979). Metacognitive regulation (i.e., regulation of cognition, see Brown, 1987; metacognitive skills, see Brown & DeLoache, 1983) refers to the executive processes which consist of activities used to oversee one's learning. These kinds of activities comprise, for example, planning, identifying the problem demands, revising problem-solving strategies, monitoring ongoing activity, evaluating and criticising the learning material, reality testing, predicting the consequences, and checking outcomes (Brown, 1978, 1987; Brown & DeLoache, 1983; see also Efklides, 2006; Veenman, 2005). Thus, in most of the studies, metacognition has been treated mainly from an individual's standpoint, and social processes have been seen as context variables which facilitate learning in individuals.

However, it is widely agreed that learning is not merely an individual process. A more complete picture of learning can be achieved when social and cultural aspects are taken into account (Lehtinen, 2003; Resnick, Levine, & Teasley, 1991; Salomon & Perkins, 1997; Vauras et al., 2008; Volet, Vauras, et al., 2009). Metacognitive reflection can be seen as the product of interaction between a person or persons and a surrounding context (see Hacker & Bol, 2004; Volet, Vauras, et al., 2009). Thus, in order to be adaptive, metacognition needs to be sensitive to contextual and situational factors; that is, metacognition needs to be conceived as being embedded in a social context (Efklides, 2009). For this reason, researchers of metacognition have increasingly begun to consider metacognition as a process which is both individual and social in nature (e.g., Efklides, 2008; Goos, Galbraith, & Renshaw, 2002; Hacker & Bol, 2004; Hogan, 2001; Iiskala et al., 2004; Jermann, 2004; Salonen, Vauras, & Efklides, 2005; Vauras et al., 2003; Whitebread, Bingham, Grau, Pino Pasternak, & Sangster, 2007).

Nonetheless, research on metacognition in collaborative situations is still rather scattered. For example, different concepts have been used, such as collective metacognition (Hogan, 2001), socially mediated metacognition (Goos et al., 2002), and socially shared metacognition (Iiskala et al., 2004). Despite the varying labels, the need for broadening the traditional view of metacognition from individual processes to collaborative ones can be seen. The same shift in emphasis is seen in more general views on regulation of learning, where the focus has been extended to co-regulation of multiple processes—including cognitive, motivational, and emotional aspects of regulation—in collaborative contexts (Salonen et al., 2005; Volet, Summers, et al., 2009; Volet, Vauras, et al., 2009).

1.2. Metacognitive regulation in high-level collaborative processes

The term "high-level collaborative processes" refers to the co-construction of meaningful knowledge and understanding in which the members of a group not only share information but are also engaged in representing each other's mental activities used to process content knowledge (Volet, Summers, et al., 2009). Thus, in high-level collaborative processes one can find, for example, sharing of speculations, of justifications, of inferences, or of identified relations—rather than just sharing information or exchanging ideas, clarifying understanding or providing definitions without evidence of transformation or integration of the other's mental representations with one's own (Volet, Summers, et al., 2009; see also King, 1998). In collaborative problem-solving, groups in which participants monitor their own and their peers' thinking seem to have an advantage over groups who do not (see Goos et al., 2002; see also Hurme, Palonen, & Järvelä, 2006). For example, Goos et al. (2002) have found very little difference in the proportion of metacognitive statements in successful versus unsuccessful problem-solving processes of small groups. Instead, differences were found in the proportions of transactive discussions, indicating that in unsuccessful problem-solving there was lack of critical engagement in monitoring each other's thinking. This finding seems to imply that in studying the quality of high-level collaborative processes, individual metacognitive events are not so critical as the constellation of shared or transactive ones at the social level. This is what the notion of distributed expertise denotes (see Brown et al., 1993); that members of a community