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The potential of stimulated recall for investigating self-regulation processes in inquiry learning with primary school students☆

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Summary This article examines the potential of using stimulated recall as a method to investigate the learning processes of primary students when engaging in inquiry based learning. Inquiry based learning requires the ability to use specific aspects of self-regulation. In the study, students were video recorded while working on a task. Immediately afterwards, they were shown selected video excerpts and interviewed about their thoughts and reasons while working on the task. In order to capture students' self-regulation, the framework for the stimulated recall is based on existing theoretical and empirical literature on self-regulation. The methodological aspects of using stimulated recall for data collection and analysis are discussed and the potential for research in science education is identified.

Introduction

Research consistently highlights the relevance of self-regulated learning for learning success in school and beyond. This is also true for inquiry based learning, as students are required to use appropriate strategies in order to investigate scientific research questions. Inquiry based learning builds on the ability to plan, monitor, control, and evaluate the progress of the investigation.

Over the years, many researchers recommended studies using video recall to assess students' thoughts and knowledge about their self-regulated learning (e.g., Järvela and Volet, 2004; Spörer & Brunstein, 2006; Winne and Perry, 2005). However, so far only few investigations used this method for the assessment of self-regulated learning (Hadwin and Oshige, 2011; Zimmerman and Schunk, 2011). The promotion of stimulated video recall based on theoretical considerations on one hand and the small number of projects implementing this method raises questions about the opportunities and difficulties in using stimulated recall for empirical research. In this paper, we concentrate on

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the use of stimulated recall with primary school students in the context of a research project on activity oriented learning within natural sciences. We seek to address the following question: What are the potential and challenges in using stimulated recall as a research method in order to examine the regulation strategies of students while working on an inquiry based learning task? As we have used stimulated recall in our research project, we will focus here on discussing the methodological aspects, in particular on data collection with stimulated recall and data analysis. First, we will discuss inquiry based learning (i). Second, the relevance of self-regulation for inquiry based learning is outlined (ii). Then, the methodological aspects of assessing self-regulation (iii) and the potential of stimulated recall for capturing self-regulation (iv) are presented. We provide a detailed account of the methodological aspects of the study, including data collection and data analysis with video recall. Results from the study provide an insight into the way, stimulated recall can be used to examine self-regulation in inquiry based learning. Finally, the potentials and limitations for using stimulated recall in the context of inquiry based learning are highlighted.

Inquiry based learning

Science education seeks to improve students' understandings of science and to increase their interest in science (Rocard et al., 2007). Scientific literacy for all students is the declared aim of science taught in schools. In order to become scientifically literate, students have to understand scientific concepts, methods, and ways of thinking (Bybee and McCrae, 2011; Kobarg et al., 2011). In recent years, inquiry based learning has become one of the most important approaches in science education (Minner et al., 2010). Inquiry based learning draws on the process of scientific inquiry, when scientists study phenomena of the natural world. It ''refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world'' (National Research Council, 1996, p. 23). Engaging students in meaningful activities whereby they can find answers to questions based on their own experiences is an essential aspect of inquiry based learning. Asking questions, planning and conducting investigations, gathering data, and drawing conclusions from evidence are all part of the active learning process.

Similar to other learning tasks, inquiry based activities can be more or less open. Bell et al. (2005) proposed a four-level model of inquiry based learning varying the amount of information given to the student. With the confirmation type of task, students receive information about the research question, method, and outcome and are asked to see whether they can confirm the experiment. Within 'structured inquiry' students are provided with the research question as well as with a description of how to proceed (often compared to a cookbook recipe). For 'guided inquiry' the question is provided by the teacher but students devise their own procedures. Finally, with 'open inquiry' students also generate their own questions. The less guidance is provided through the teacher and his or her written instructions, the more the learning process depends on the students' self-regulation.

Self-regulated learning

For the conceptualization of self-regulation various models have been proposed; although differing in detail, all agree that self-regulated learning involves cognitive, emotional, motivational, and behavioural components allowing individuals to realise their goals and actions within an ever changing environment (Zeidner et al., 2005). Comparable to inquiry based learning, definitions of self-regulated learning emphasize the active role of the learner (e.g., Pintrich, 2005; Rheinberg et al., 2005; Zimmerman, 2005). Pintrich's model of self-regulated learning (1999, 2004, 2005) differentiates between four phases of self-regulation and four areas in which regulation of the learning process can be necessary. The first phase comprises forethought, planning, and activation. The second phase is called monitoring and includes metacognitive awareness of task progression and learning. The third phase involves processes of control and regulation. During the fourth phase, reactions to and reflections about the outcome and results are needed in order to complete the learning process. Pintrich (2005) emphasizes that these four phases can occur simultaneously and do not necessarily follow a strict linear sequence. This is especially true for the second and third phase. The four phases of self-regulated learning relate to aspects of cognition (e.g., goal setting, prior content knowledge activation), motivation (e.g., interest activation, attributions), behaviour (e.g., increase of effort, help-seeking), and context (e.g., monitoring changing task and context conditions), respectively. The resulting grid of phases and areas provides a comprehensive framework for the study of self-regulated learning in the classroom (Table 1).

Table 1 Framework for phases and areas for self-regulation (abbreviated from Pintrich, 2004, p. 390).

Phase	Areas for regulation (examples)
Phase 1	Goal setting
Forethought, planning and activation	Activation of prior content knowledge
	Perception of task difficulty
Phases 2 and 3	Awareness and monitoring of
Monitoring and control	cognition, effort, time use, need for help
	Monitoring changing task and context conditions
	Selection and adaptation of strategies for working on the task
Phase 4	Cognitive judgments
Reaction and reflection	Affective reactions
	Evaluation of the task