Teaching and Teacher Education 47 (2015) 108–119

Contents lists available at ScienceDirect

Teaching and Teacher Education

journal homepage: www.elsevier.com/locate/tate

How teacher professional development regarding classroom dialogue affects students' higher-order learning

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HIGHLIGHTS

- The effectiveness of the teacher professional development (TPD) program was proven.
- Students benefit regarding situational and enduring facets of higher order learning.
- Students with low self-concept benefit regarding situational learning processes.
- Students with high self-concept improve regarding cognitive elaboration strategies.

ARTICLE INFO

Article history:
Received 20 February 2014
Received in revised form
17 December 2014
Accepted 22 December 2014
Available online

Keywords:
Classroom dialogue
Higher-order learning
Cognitive learning strategies
Teacher professional development
Video
Self-concept of ability

ABSTRACT

The present study investigated the effects of a teacher professional development program targeting the effects of productive classroom dialogue on students' perceived situational learning processes and cognitive elaboration strategies. The participants involved 136 students in an intervention group and 90 students in a control group; the results showed that professional development was effective for the intervention group in both dependent variables. Further differential analysis revealed that students with a low self-concept particularly benefited from the treatment, especially for their situational learning processes. The study contributes to systematic research on teacher professional development effectiveness and student learning.

1. Introduction

Worldwide, there is a high demand for young people to choose careers in STEM (science, technology, engineering, and mathematics) disciplines (Organisation for Economic Co-operation and Development (OECD), 2007). Educational researchers and policy makers agree on the importance of teachers' knowledge about fostering and scaffolding deeper student understanding of STEM subjects (National Research Council, 2007). Therefore, the present study examines the effects of a video-based professional development program for teachers on classroom dialogue in mathematics and science. Classroom dialogue was examined because it is the predominant mode of teaching (Hiebert et al., 2003), and its quality plays a crucial role in the way students acquire knowledge (Alexander, 2005). In the Western educational context, in particular, dialogue is considered essential for effective pedagogy (Howe & Abedin, 2013). It is therefore important to learn more about the elements that make classroom dialogue a meaningful learning experience for students (Furtak, 2006; Kovolainen & Kumpulainen, 2005; Mercer & Littleton, 2007).

Two key elements of classroom dialogue have been identified as useful for students' higher-order learning: the encouragement of active student engagement (i.e., by challenging teachers' questions) and scaffolding student thinking (i.e., by structuring a lesson) (Lee & Kinzie, 2012; Resnick, Michaels, & O'Connor, 2010; Seidel & Shavelson, 2007; Walshaw & Anthony, 2008). As previous studies have reported, rather rigid conversational patterns provide limited opportunities for student interaction (Hugener et al., 2009; Jurik, Gröschner, & Seidel, 2013; Lipowsky et al., 2009), and teachers

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http://dx.doi.org/10.1016/j.tate.2014.12.007
0742-051X/

sometimes find it difficult to modify their habitual teacher–student interactions toward a richer and more purposeful verbal exchange (Alexander, 2005; Osborne, Simon, Christodoulou, Howell-Richardson, & Richardson, 2013). As research shows, such purposeful verbal exchanges are challenging since they require new routines for classroom interactions (Mercer & Howe, 2012).

Given the current state, the development and systematic examination of the types of teacher professional development (TPD) that improves classroom dialogue seems important. Recently, efforts have been made to design such programs in the international context. In "Accountable Talk," for example, teachers learn about concrete talk moves that actively engage and connect students in conversation (Michaels & O'Connor, 2012). In the "Cam Talk" program, Higham, Brindley, and Van de Pol (2014) worked with teachers on opening up their classroom dialogue so students could co-construct knowledge rather than having the teacher imposing the content on them. With this present study, we add to these research efforts and present the effects of the "Dialogic Video Cycle," a newly designed program that aims to improve classroom dialogue by the use of video as a reflective tool (Gröschner, Seidel, Kiemer, & Pehmer, 2014).

TPD is typically investigated in terms of its effects on teachers' learning and changes in practice (Desimone, 2009; van Veen, Zwart, & Meirink, 2012). However, it has rarely been asked to what extent TPD results in changes regarding students, such as student perceptions of their learning during instruction (Könings, Seidel, Brand-Gruwel, & van Merriënboer, 2013). In this context, the research has emphasized the importance of students' positive perceptions of higher-order learning, which allows for a deeper understanding of class material (Darling-Hammond & Bransford, 2007; Donovan & Bransford, 2005; Resnick, 1989; Seidel & Shavelson, 2007). The present study aims to provide evidence targeting this research gap. Using a longitudinal control group design, this study shows how a TPD program on classroom dialogue affects students' higher-order learning. Specifically, higher-order learning is investigated as a first research question by asking how students perceive their situational learning processes as well as their intentional use of cognitive elaboration strategies. Thereby, it is important to acknowledge differences in student characteristics (Snow, Corno, & Jackson, 1996), such as self-concept of ability. According to recent research, self-concept of ability is an important precondition for students' motivation to actively engage in classroom dialogue (Jurik et al., 2013). The second research question investigated students' changed perceptions of situational learning processes and cognitive elaboration strategies by taking students' self-concept of ability into consideration.

2. Theoretical background

2.1. Productive classroom dialogue: fostering and scaffolding higher-order learning in students with differences in domain-specific self-concept of ability

2.1.1. Higher-order learning: students' perception of situational learning processes and cognitive elaboration strategies

Research on TPD has found that effective interventions should lead to changes in teaching (Desimone, 2009; van Veen et al., 2012) and/or student outcome variables (Fishman, Marx, Best, & Tal, 2003). In this context, the present study concentrates on students' higher-order learning as an important outcome variable of teacher–student interactions in the era of global reforms in teaching and learning (OECD, 2007). Higher-order learning can be characterized by *situational learning processes* that focus on the question of how students perceive their learning in a current lesson, and *cognitive elaboration strategies* that determine students' use of certain strategies to support their learning in a more habitual and constant way (Vermunt, 1996; Vermunt & Verloop, 2000). Both aspects are particularly relevant for deeper student understanding of learning content (Donovan & Bransford, 2005).

2.1.1.1. Situational learning processes. A positive perception of situational learning processes is an important prior condition for student learning (Donovan & Bransford, 2005). In this context, one must ask whether a student is able to follow and process the lesson (processing), activate and integrate knowledge (elaborating), as well as structure and organize the gained knowledge (organizing). The procedures of processing, elaborating, and organizing are basically characterized as the essential *situational* elements of higher-order learning (Collins, Brown, & Newman, 1989; de Corte, Verschaffel, Entwistle, & van Merriënboer, 2003; Donovan & Bransford, 2005).

2.1.1.2. Cognitive elaboration strategies. Beyond situational learning processes, cognitive elaboration strategies are relevant for higher-order learning (Weinstein & Mayer, 1986). Cognitive learning strategies, of which elaboration strategies are a part, are assumed to be more enduring (Vermunt, 1996), and are intentionally used by learners (Zimmerman & Martinez-Pons, 1990). In the context of productive classroom dialogue, in which students are verbally challenged to offer explanations and evidence (Duschl & Osborne, 2002), cognitive *elaboration* strategies are regarded as students' intentional use of strategies to connect existing knowledge to previous knowledge and using knowledge in a new context (Weinstein & Mayer, 1986). When teachers in a TPD program on classroom dialogue learn about the importance of challenging their students (i.e., by pressing them to elaborate on their explanations), the role of cognitive elaboration strategies and changes in students' perception of them over a period of time should be considered.

In summary, research shows the relevance of higher-order learning when students are asked to develop a deeper understanding of learning content (Donovan & Bransford, 2005; Weinstein & Mayer, 1986). To date, however, little is known about exactly how productive classroom dialogue can support students' situational learning processes and cognitive elaboration strategies. Until now, these research fields have not yet been fully investigated with empirical studies. The present study contributes to close this gap.

2.1.2. The impact of productive classroom dialogue on students' higher-order learning

In the international context, classroom dialogue is the predominant mode of teaching (Hiebert et al., 2003). However, it often follows rigid interactional patterns in which the teacher initiates a conversation primarily by asking a question or giving a task (I = initiation), followed by a student's response (R = response) and the teacher providing an evaluation of the statement (F = follow-up) (Cazden, 2001; Lemke, 1990; Mehan, 1979). Mercer and Dawes (2014), who examined the talk between teacher and students over the last 40 years, reported the described I-R-F pattern as often being considered state of the art in today's classrooms in Western countries. However, it often lacks quality, which indicates that the teacher's initiation does not necessarily activate and challenge students, even though it could be an important tool for doing so and influencing the quality of student contributions (Chin, 2006; Lee & Kinzie, 2012; Oliveira, 2010). Studies have shown that teachers would rather stick to a "secure" script by asking questions that allow only for short, non-elaborate student responses. Student answers in this conversation pattern serve as key words for the teacher's teaching script (Jurik et al., 2013; Mercer & Dawes, 2014). At the same time, this script fails to provide opportunities for