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Bridging the gap between theory and practice – The effective use of videos to assist the acquisition and application of pedagogical knowledge in pre-service teacher education

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1. Introduction

In many countries teacher training is organised in such a way that future teachers should first acquire a relevant knowledge base within the framework of their university studies. Then later they should apply it in the school environment. This is also the case in Germany where our study reported here was conducted, because teacher education is strictly divided in two consecutive phases. In the first university phase (4–5 years), future teachers study two subjects and take educational courses with a strong emphasis on theory. In the following practical phase (1.5 years), they teach classes but are paired with experienced teachers as mentors.

Against this background there are often concerns that the knowledge acquired at university remains idle and is being lost when entering the profession. Such concerns are associated with calls to link the acquisition of basic pedagogical knowledge directly with its application (Blömeke, Suhl, & Kaiser, 2011; Darling-Hammond & Bransford, 2007; Feiman-Nemser, 2001; Grossman, 2005; Korthagen, 2010; Korthagen, Kessels, Koster, Wubbels, & Lagerwerf, 2001). In order to be able to meet this requirement in the training of pre-service teachers, specific learning opportunities must be created and be effectively designed so that the desired objective – the connection between the acquisition and application of pedagogical knowledge – can be achieved.

An appropriate means of strengthening this required connection is the use of videos. Videos can represent authentic teaching situations and provide opportunities to learn how lessons are to analyse in terms of effectiveness for pupils' learning. However, pre-service teachers are largely unable to identify the relevant events of classroom teaching (Sherin & van Es, 2009) because "they lack sufficient knowledge about the teaching profession and specific subject areas" (Gaudin & Chaliès, 2015, p. 46). Therefore, pre-service teachers have to acquire the necessary basic knowledge. In order to avoid that this theoretical knowledge remains inert, it must be introduced with reference to concrete contexts according to the theory of situated learning (Korthagen, 2010). In this regard, videos are an appropriate means for providing such contexts. However, the knowledge acquired in this way must be subsequently applied to different situations in order to decontextualize the knowledge and to make it a flexible cognitive tool to understand and manage further situations. This application process can also be supported by videos representing suitable situations.

A whole string of studies, especially in the area of mathematics teachers' education, examined the use of video regarding the acquisition and application of knowledge. For instance, Borko, Koellner, Jacobs, and Seago (2011) used videos to promote teachers' content knowledge and pedagogical content knowledge. Santagata and Guarino (2011) provided pre-service teachers with knowledge and skills to analyse and reflect on mathematics teaching. And van Es, Tunney, Goldsmith and Seago (2014) investigated the question how to facilitate the analysis of mathematics teaching practice with videos in order to draw more attention to students' mathematical thinking.

In comparison with the area of mathematics teachers' education, there are very few studies aiming at strengthening the connection between the acquisition and application of pedagogical knowledge. Exceptions are the studies of Stürmer and colleagues (Stürmer, Könings, & Seidel, 2012; Stürmer, Seidel, & Schäfer, 2013) focusing on principles of teaching and learning. These studies set priorities to three principles (goal orientation, teacher support, learning climate) and could show that the use of videos fosters the acquisition and application of these principles.

Against the background of these studies we were interested in the question, whether the use of videos is also an effective method to applicate knowledge about further well-known principles on effective teaching (e.g. using succinct examples, relating cognitive activities to prior knowledge, cognitive activation etc.).

This question was the starting point for the study on which we report here. The study took as its basis the implementation of a curriculum (treatment), through which pre-service teachers had the opportunity to acquire theoretical knowledge about the principles of effective teaching and to apply this knowledge to the analysis of videotaped lessons of others. We consider knowledge about these principles of teacher behaviour that are positively connected with student achievements to be an important part of pedagogical knowledge. The

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evaluation was carried out using a Solomon Four-Group Design. The main research question was: Are the participants in the experimental group (use of videos) in a better position than the participants in the control group (no video) to apply the theoretical knowledge to the evaluation of teaching situations?

1.1. Criteria for the precise description of the use of videos in pre-service teacher education

Videos have been used in pre-service teacher education for almost three decades. As the extensive literature review by Blomberg, Renkl, Sherin, Borko, and Seidel (2013) shows, a wide range of intentions have been pursued through this: acquiring teaching skills through micro-teaching, specification of a theoretical concept, analysis of interactions, transfer of classroom management skills, reflection on teaching behaviour, awareness of the thought processes of pupils, etc. These examples are evidence that the use of videos is not an end in itself, rather it is always linked with specific intentions (Brophy, 2004; van Es et al., 2014).

Although many of the studies on the use of videos report positive learning effects (see Blomberg et al., 2013), these effects are not easy to assess. The majority of the studies considered by Blomberg et al. (48 out of a total of 65) were qualitatively oriented. Their strengths lie in the fact that they document individual examples of successful learning processes. However, due to their more exploratory nature and the relatively small number of participants it remains unclear as to whether the effects reported in these studies of video use can also be applied to larger populations. A further difficulty for evaluating the results is that "most reports provide little detail concerning exactly how the video is used in teacher education activities. Hence, the principles behind the different video applications remain unclear. Specifically, the use of video is mostly described in quite general terms." (Blomberg et al., 2013, p. 94)

Despite these restrictions, on the basis of the 65 studies, Blomberg et al. were nevertheless able to identify the strengths and weaknesses of videos as a medium for supporting the learning outcomes of pre-service teachers. From this analysis they derived five research-based heuristics that allow for a precise description of the use of video:

1. Videos only reveal their potential, if clear objectives determine the design of the offered learning opportunities (Krammer et al., 2006). 2. Pre-service teachers can quickly become cognitively overloaded when viewing videos (Erickson, 2007) and may focus on irrelevant aspects. In order to limit the cognitive load and to focus on the essential features, the analysis of videos should therefore be guided by specific instructions and tasks. 3. A decision has to be made as to whether someone else's or one's own lesson is to be analysed and the level of quality that the lesson observed should have (best practice or typical practice). 4. In addition to the benefits, the limitations of the use of videos need to be determined. In particular, the presentation of very short video clips can be problematic, so that further background information (e.g. additional texts) needs to be provided. 5. Appropriate instruments for evaluating the level of learning success need to be available or developed. In accordance with video-based instruction the assessment of learning increases should also generally be video-based.

Blomberg et al. (2013) see in these five heuristics great potential for future research on the use of video. This is because currently "there is still a lack of well-founded knowledge about how to properly understand and use video as a technological tool … In particular, experimental or quasi-experimental studies are required" (Blomberg et al. (2013), p. 106). We share this view and have therefore used the five detailed heuristics to design our study, in order to check whether the use of videos can effectively support the acquisition and application of pedagogical knowledge.

1.2. Principles of effective teaching (as an important part of pedagogical knowledge)

Knowledge is a key component of teachers' professional competence because it makes a significant contribution to effective teaching and student learning (Baumert & Kunter, 2013; Darling-Hammond & Bransford, 2007; Gitomer & Zisk, 2015; Grossman & McDonald, 2008; Munby, Russell, & Martin, 2001; Shulman, 1986; Woolfolk Hoy, Davis, & Pape, 2006). With regard to the structure of this knowledge, Shulman (1986) initially distinguished between general pedagogical knowledge, subject-matter content knowledge, pedagogical content knowledge and curricular knowledge. This proposition provoked an intense discussion and led to an abundance of suggestions of how to classify knowledge. But in most research projects that investigated the role of teachers' knowledge (e.g. Borko, 2004; Blömeke et al., 2011; Baumert & Kunter, 2013; König et al., 2014; Munby, Russel, & Martin, 2001), the distinction between pedagogical knowledge, content knowledge and pedagogical content knowledge was proved in practice.

In the context of our research question, our study is about the acquisition and application of pedagogical knowledge. We operationalise this broad concept by focusing on a specific part of this knowledge, namely knowledge about the principles of effective teaching. These principles of effective teaching are an important part of pedagogical knowledge because the success of teaching largely depends on whether a teacher knows and can use these principles of teaching that initiate meaningful learning and that can lead to visible learning results (Fiorella & Mayer, 2015). In comparison with other facets of pedagogical knowledge (e.g. curricular knowledge, knowledge of educational contexts, knowledge of educational purposes and their historical grounds; see Shulman, 1987) these features describe the teaching behaviour in a very direct way. Therefore they are particularly well suited to being used as criteria, in order to properly perceive and assess videotaped lesson in terms of the effectiveness of learning. In this respect, we consider the use of videos as a successful way to connect the acquisition of pedagogical knowledge and its application to documented teaching scenarios.

The principles of effective teaching have been a focus of research for around 35 years. In this period a great number of individual studies have been conducted which have been able to identify the specific characteristics of teachers' behaviour that are positively connected with student achievements. Literature reports and meta-studies in which several hundred such individual studies have been combined (see for example Brophy & Good, 1986; Hattie, 2009; Kyriakides, Christoforou, & Charalambous, 2013; Muijs et al., 2014; Seidel & Shavelson, 2007) show a high degree of conformity with regard to these eleven principles of effective teaching: (1) opportunity to learn and time on task; (2) goal orientation; (3) structuring; (4) clarity; (5) cognitive activation/motivation; (6) relating cognitive activities to prior knowledge; (7) feedback/evaluation/assessment; (8) using appropriate examples; (9) adapting/differentiating instruction; (10) application/transfer; (11) classroom climate/learning atmosphere. These principles are compiled and briefly defined in Table 1. Additionally, corresponding references to relevant meta-analyses and literature reports, which consistently support the empirical evidence and theoretical plausibility of these principles, are provided.

1.3. Hypotheses

In order to answer our research question we used a Solomon Four-Group Design with two experimental groups (A1 and A2) and two control groups (B1 and B2). In both the experimental and the control groups the participants had the opportunity to acquire pedagogical knowledge (i.e. knowledge about principles of effective teaching behaviour). However, only in the experimental groups videos were used (treatment), so that the participants could also apply their knowledge by watching concrete teaching situations.