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Time for a new approach to prepare future teachers for educational technology use: Its meaning and measurement

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A R T I C L E I N F O

A B S T R A C T

The main objective of this study is to develop a self-report instrument to measure pre-service teachers' perceptions of the extent to which they experience the necessary support and training in order to integrate technology into classroom activities. The questionnaire items of this instrument were drawn up on the basis of a synthesis of 19 qualitative studies (Tondeur, van Braak, Sang, Voogt, Fisser, & Ottenbreit-Leftwich, 2012) and were reviewed by experts in the field. In order to study its reliability and aspects of validity, data were collected and analysed consisting of a sample of 688 pre-service teachers in Flanders (Belgium). The resulting scale showed highly satisfactory psychometric properties. Item response theory revealed a good fit of the measurement to a Rating Scale Model for 22 out of 24 items. The results also indicate that the items differ in their degree of difficulty. It seems that helping pre-service teachers to design ICT-rich lessons and providing adequate feedback can be considered more challenging for teacher training institutions. Recommendations are given regarding how the new scale can be useful for both teacher training institutions and schools in developing approaches to equip pre-service teachers with the competencies needed to integrate technology in teaching and learning processes.

1. Introduction

In this digital age, teacher training institutions (TTI) are expected to prepare pre-service teachers to adequately use technology in their educational practice (e.g., Brun & Hinostroza, 2014; ISTE, 2012; Kaufman, 2015). TTIs around the world have therefore engaged in various efforts to re-shape their curriculum (Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010; Tømte, Enochsson, Buskqvist, & Kårstein, 2015). More specifically, they have infused technology into the entire curriculum, giving pre-service teachers the opportunity to understand the pedagogical reasons for using technology by experiencing first-hand how it can support teaching and learning across different subjects (Tondeur et al., 2012; Polly, Mims, Shepherd, & Inan, 2010). A number of approaches that may develop the competences that future teachers require in this context have already been identified by previous research (Chien, Chang, Yeh, & Chang, 2012; Lee & Lee, 2014; Valtonen et al., 2015). However, promoting pre-service teachers' competencies for educational technology use in an integrated and cross-

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curricular manner is a complex process that demands multiple strategies (Kay, 2006; Mouza, Karchmer-Klein, Nandakumar, Ozden, & Hu, 2014; Polly et al., 2010).

These strategies were listed and reviewed by Tondeur et al. (2012) and an overarching SQD-model (Synthesis of Qualitative Evidence) was developed to present how they relate to each other/to present their complex interrelations. After this model had been introduced, it became clear that the next step would be to assess to what extent these strategies are actually implemented by TTIs. However, no comprehensive instruments that assess effective strategies to prepare future teachers for technology integration have been described in the research literature. This study intends to address this gap in the existing literature by providing an instrument that does precisely that. More concretely, the current research has three specific aims: 1) to develop a self-report instrument based on a theoretical model to measure pre-service teachers' perceptions of the extent to which they experience the necessary support and training in order to integrate technology into classroom activities; 2) to use IRT (Item Response Theory) to establish a reliable scale; and 3) to explore the item difficulties of strategies to prepare pre-service teachers for technology use. This will lead to a better understanding of the support future teachers need for the use of technology in education.

Before presenting the results of the study, we first examine the literature upon the complexity of technology in teacher education and the choice of IRT as a method of data collection. This will be followed by a description of the design study and conclude with a discussion on the implications for practice: how the proposed instrument could be used 1) to frame and improve the training of future teachers to effectively integrate technology in their teaching and learning practices and 2) in structuring the professionalization of the teacher educators.

2. Research overview

2.1. Teacher education and technology use

The new generation of teachers faces considerable demands with respect to the use of new technologies in education (OECD, 2010). As a result, TTIs are compelled to respond to a society driven by technology and to seize the opportunities it creates for education (Chien et al., 2012; Kaufman, 2015). According to the standards set for teachers, TTIs should facilitate such learning events, design and develop learning experiences and assessments fit for the digital age, model 21st century learning, promote digital citizenship, and engage in ongoing professional development and leadership of technology use (ISTE, 2012; Kennisnet, 2012; UNESCO, 2008).

In this respect, TTIs are expected to provide new teachers with the competencies to integrate technology into education and to educate pupils to become ICT competent (see e.g., Brun & Hinostroza, 2014; Tømte et al., 2015). To respond to this expectation, many institutions have included introductory technology courses, primarily focused on the development of technological knowledge and skills (Polly et al., 2010). However, several studies suggest that technology is often under-used by pre-service teachers and beginning teachers (Agyei & Voogt, 2011; Chien et al., 2012; Sadaf, Newby, & Ertmer, 2012). Moreover, it seems that only a small number of pre-service and beginning teachers are able to use technology in diverse and flexible ways (Tondeur et al., 2012; Bate, 2010; Gao, Wong, Choy, & Wu, 2011).

According to Ottenbreit-Leftwich et al. (2010), there is a clear discrepancy between what pre-service teachers are taught in their courses and how teachers actually use technology in a real classroom. Therefore, Koehler and Mishra (2009) argued that TTIs should not only focus on how to use technology but also how technology intersects with pedagogical and content knowledge, as directed by the concept of Technological Pedagogical Content Knowledge (TPACK). Further research on the development of ICT capabilities for pre-service teachers reveals that technology should be infused into the entire curriculum (Tondeur, Pareja Roblin, van Braak, & Voogt, 2014). Without such integrated approaches, Polly et al. (2010) predict that the competencies pre-service teachers gain are likely to remain isolated and unexploited. Practical experiences worldwide have corroborated the potential of such integrated approaches as well as the difficulties associated with their implementation (Drent & Meelissen, 2008; Mouza et al., 2014).

2.2. Strategies to prepare future teachers for technology use

Numerous strategies have been proposed in the literature to facilitate integrated approaches to prepare pre-service teachers for technology use (e.g., Agyei & Voogt, 2011; Banas & York, 2014; Jang, 2008; Niess, 2005). To illustrate, the "Preparing Tomorrow's Teachers to Use Technology" (PT3) programme provided funds to support the development of teacher technology learning experiences (see Tondeur et al., 2012). This programme emphasized technology training in authentic teaching situations (based on Kay, 2006; Ottenbreit-Leftwich et al., 2010; Polly et al., 2010): hands-on technology skill-building activities (e.g., workshops), collaboration among pre-service teachers (e.g., design teams), practicing technology in the field (e.g., field experiences), and technology integration reflections (e.g., electronic portfolios).

It is clear that effective preparation of pre-service teachers for technology integration does not only require attention to the separate strategies, but also the combination of different approaches (Chien et al., 2012; Kay, 2006; Mouza et al., 2014). To illustrate, the study of Chien et al. (2012) is based on a combination of four steps (i.e., Modelled Analysis, Guided Development, Articulated Implementation, and Reflected Evaluation) for "assisting science teacher educators in closing the gap between instructional design and technology design while teaching technology integration" (p. 579). Specifically, the aim of