



Becoming more specific: Measuring and modeling teachers' perceived usefulness of ICT in the context of teaching and learning



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ARTICLE INFO

Article history:

Received 22 November 2014

Received in revised form

25 February 2015

Accepted 29 May 2015

Available online 6 June 2015

Keywords:

Bayesian analysis

Measurement

Perceived usefulness of ICT

Structural equation modeling

Technology acceptance

ABSTRACT

Studies on teachers' acceptance and use of information and communication technology (ICT) have revealed perceived usefulness to be a crucial determinant for integrating ICT in classrooms. In consequence, the present study focuses on teachers' perceived usefulness of ICT for teaching and learning and is aimed at describing its structure and relations to self-efficacy, ICT use, and teachers' age. By means of Bayesian analysis, we specified confirmatory factor-analytic and structural equation models to a large-scale data set of $N = 1190$ Norwegian teachers. Our results supported the hypothesized four-factor structure of teachers' perceived usefulness of ICT, signifying different facets of ICT-related teaching goals in classrooms. Moreover, it was possible to disentangle general and specific components of the construct in nested factor models. In support of existing research, we found positive relations to self-efficacy and ICT use, but a negative relation to teachers' age. Our study provides evidence on a multi-dimensional conceptualization of teachers' perceived usefulness of ICT for teaching and learning, and verifies the relations to teacher-related characteristics. Implications for the measurement and modeling of the construct, and future research directions are discussed.

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1. Introduction

The development of students' digital competences has become an important goal in 21st century education (Griffin, Care, & McGaw, 2012; OECD, 2014; Tristán-López & Ylizarituri-Salcedo, 2014). Recent educational research is therefore concerned with the determinants of students' digital competences on the one hand (Aesaert, van Nijlen, Vanderlinde, & van Braak, 2014; Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014; Fraillon, Schulz, & Ainley, 2013; Kikis, Scheuermann, & Villalba, 2009); and teachers' integration of ICT in classrooms on the other hand (Donnelly, McGarr, & O'Reilly, 2011; Hernández-Ramos, Martínez-Abad, GarcíaPeñalvo, HerreraGarcía, & Rodríguez-Conde, 2014; Sang, Valcke, van Braak, & Tondeur, 2010; Teo, 2011a). In particular, research has shown that there are a number of factors determining teachers' ICT integration such as teachers' attitudes towards ICT, ICT experience and skills, self-efficacy, and perceived usefulness of ICT (Govender & Govender, 2009; Hernández-Ramos et al., 2014; So, Choi, Lim, & Xiong, 2012; Teo, 2011b). Of the factors mentioned, teachers' perceived usefulness of ICT has received special attention in the context of technology acceptance and use: Perceived usefulness is regarded as the only construct which directly predicts teachers' intentions to use ICT and their attitudes towards computer use, which are determinants of the actual ICT use (Chien, Wu, & Hsu, 2014; Davis, 1989; Oye, Iahad, & Rahim, 2014; Smarkola, 2008; Teo, 2011a, b; Teo, Lee, Chai, & Wong, 2009). Moreover, perceived usefulness is the strongest predictor of teachers' intention to use ICT (e.g., Teo, 2009).

The current conceptualizations of perceived usefulness of ICT operationalized the construct at a general level, referring to whether teachers generally regard ICT as useful to increase their job performance (Venkatesh, Morris, Davis, & Davis, 2003). Hence, when studying the nature of the construct, most studies assumed unidimensionality and found support by using confirmatory factor analysis (e.g., Chien et al., 2014; Hernández-Ramos et al., 2014; Liaw & Huang, 2013; Teo, 2009). From a conceptual point of view, the unidimensional

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conceptualization is critical, as it does not account for the *specific* goals of teachers' job performance facilitating teaching and students' learning (Niederhauser & Perkmen, 2010). Since the *specific* purposes of using ICT for teaching and the *specific* goals to foster students' learning are multifaceted (e.g., using ICT for assessment, collaboration, feedback, skill development; Proctor & Marks, 2013; Schroeders & Wilhelm, 2011; Terzis & Economides, 2011), one may also conceptualize perceived usefulness as multidimensional. In other words, teachers' perceptions on whether ICT could improve their job performance may not only refer to the use of ICT in *general* (unidimensionality) but rather to the usefulness of ICT for *specific* teaching and learning purposes in classrooms (multidimensionality). In addition to this conceptualization, one needs to take into account that teaching and learning goals are often overlapping, thus challenging the modeling of the factor structure (construct overlaps). Consequently, there is a need for a modeling approach that represents the conceptualization of teachers' perceived usefulness with respect to the specific goals of using ICT in classroom instruction.

In light of this argumentation, the present study proposes a multidimensional conceptualization of perceived usefulness of ICT for teaching and learning and is aimed at (a) testing the hypothesis of a multidimensional factor structure of the construct and potential overlaps between the factors; and (b) investigating the relations to external variables (teachers' ICT self-efficacy, ICT use, age) as a step of construct validation. We use Bayesian analyses to address our aims. Since perceived usefulness is a key element of technology acceptance, our study provides insights into the nature of the construct, impacting future modeling of technology acceptance.

2. Theoretical framework

2.1. Conceptualizing teachers' perceived usefulness of ICT for teaching and learning

In the context of technology acceptance, researchers are concerned with the factors determining teachers' attitudes towards and their intention to use ICT (Davis, 1989; Teo, 2009), of which *perceived usefulness* is one of the most important determinants (e.g., Chien et al., 2014; Niederhauser & Perkmen, 2010; Oye et al., 2014; Teo, 2011a, b; Teo & Noyes, 2011). Perceived usefulness is part of teachers' belief system and refers to their individual beliefs that using ICT will help them improve their job performance (Davis, 1989). The construct can be distinguished from teachers' general attitudes towards the use of computers, as it does not rely on their positive feelings about using ICT in general (Ifenthaler & Schweinbenz, 2013; Niederhauser & Perkmen, 2010; Teo & Noyes, 2011). In current research on technology acceptance, perceived usefulness has been conceptualized broadly, focusing on the potential improvement of teachers' *general* job performance when using ICT, without defining the *specific* aspects of 'job performance' (e.g., Teo, 2011a). Nevertheless, since teachers' job performance in the context of ICT is complex, particularly in fostering students' competences of accessing, retrieving, evaluating, and communicating digital information, the question on the specificity of perceived usefulness for teaching and learning arises.

Against this background, conceptualizations of perceived usefulness that are linked to aspects of teaching performance may account for the specific attainment goals in the curricula, which are students' digital competences. Digital competences are often conceptualized as constructs that comprise different sub-dimensions or cognitive processes. For instance, Claro et al (2012) refer to ICT skills in information sourcing, information retrieval, effective communication, collaboration and virtual interaction, evaluation of ICT use with respect to ethics and social impact. Ferrari (2013) proposed a framework which extended these sub-dimensions by introducing problem solving and creative skills. On the basis of the many conceptualizations, Aesaert et al. (2014) concluded that digital competences should be regarded as multidimensional. Moreover, the authors stressed the importance of information processing and communication skills as crucial factors. These conceptualizations align with the common understanding of what information and communication technology (ICT) refers to: Toomey (2001) proposes that ICT "relates to those technologies that are used for accessing, gathering, manipulating and presenting or communicating information" (in Lloyd, 2005, p. 3). In this sense, ICT does not only include specific hardware but also software applications and connectivity (e.g., Internet, local networks) to enact these skills.

Given the multidimensionality of digital competences, teachers' use and perceived usefulness of ICT for teaching and learning may directly refer to the sub-dimensions of digital competences (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Hermans, Tondeur, van Braak, & Valcke, 2008). Antonietti and Giorgetti (2006) pointed out that teachers' use of ICT in classroom instruction should be oriented towards fostering students' interest and higher-order cognitive activities, along with the optimization of learning processes and learning outcomes. These considerations on students' digital competences and teachers' use of ICT in classrooms suggest taking a multidimensional perspective of perceived usefulness.

So far, the conceptualization of perceived usefulness of ICT for teaching and learning addressed teachers' positive perceptions of ICT. However, teachers' perceived usefulness with respect to the *problems and obstacles* that using ICT may impose in classroom instruction might differ from their perceptions of the *benefits* of using ICT (Carstens & Pelgrum, 2009). Moreover, research on perception-based evaluations of behavioral or personality-related constructs indicated that individuals respond differently on items that relate to negative or positive perceptions (Ibrahim, 2001). In fact, the different response tendencies could create further sources of variability in measurement models (Preckel, 2014). Hence, in order to cover a broader range of teachers' perceived usefulness of ICT, assessments may also capture teachers' negative perceptions accounting for the problems and obstacles of ICT in classroom instruction (Player-Koro, 2012).

Taken together, given the multiple teaching purposes of using ICT, a *multidimensional and specific* perspective differentiating between factors of perceived usefulness for teaching and learning may represent the construct more appropriately than a *unidimensional and general* view. For instance, one may think of focusing on the following aspects of positive usefulness of ICT (Antonietti & Giorgetti, 2006; Ferrari, 2013; Hernández-Ramos et al., 2014): Fostering interest and learning, fostering collaboration and communication, fostering information retrieval. In addition, looking at negative perceptions as causing problems and creating obstacles extends this conceptual perspective. Consequently, the measurement of perceived usefulness in our study requires specific items that are linked to teachers' positive and negative perceptions, and represent the multidimensionality of teaching goals and the digital competences that students should acquire in learning with ICT.

2.2. Measuring teachers' perceived usefulness of ICT for teaching and learning

As mentioned previously, the measurement of teachers' perceived usefulness has taken a rather general approach until now. In particular, the construct is mostly measured by items such as 'Using technology improves my performance', which rely on a *general*

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