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Revisiting teachers' computer self-efficacy: A differentiated view on gender differences

Ronny Scherer [a,*], Fazilat Siddiq [b]

[a] Centre for Educational Measurement at the University of Oslo (CEMO), Faculty of Educational Sciences, University of Oslo, Norway
[b] Department of Teacher Education and School Research (ILS), Faculty of Educational Sciences, University of Oslo, Norway

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ABSTRACT

Gender differences in computer-related constructs have been identified for teachers and students. The present study investigated such differences by focusing on teachers' computer self-efficacy (CSE), which is conceptualized as their confidence in performing basic and advanced skills in using computers, along with the use of computers for instructional purposes. Analyzing the data from 1208 Norwegian secondary school teachers who participated in the International Computer and Information Literacy Study (ICILS) 2013 by means of multi-group confirmatory factor analysis, we found that: (a) CSE can be described by three factors (self-efficacy in basic operational skills, advanced operational and collaborative skills, and in using computers for instructional purposes) which remain invariant across gender; (b) male teachers had higher CSE in basic ($d = -1.03$) and advanced operational skills ($d = -0.49$); (c) no significant gender differences for CSE in using computers for instructional purposes existed; (d) teachers' CSE was differentially related to their participation in professional development courses for females and males. The differentiation into three factors of CSE provides a more detailed view on teachers' CSE than unidimensional approaches. We discuss our findings in light of gender differences and teachers' professional development in using information and communication technology.

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1. Introduction

Research on teacher education, effectiveness, and personality has identified teachers' self-efficacy beliefs as important determinants of their well-being, job satisfaction, instructional behavior, and students' achievement (e.g., Caprara, Barbaranelli, Steca, & Malone, 2006; Klassen & Tze, 2014). The importance of these beliefs has also been recognized in the context of technology acceptance and integration into classrooms. In particular, a number of studies showed significant relations between teachers' computer self-efficacy, their intention to use computers, and their actual use of computers for instructional purposes (Teo, 2011; Wong, Teo, & Russo, 2012), thus pointing to the importance of self-efficacy for 21st century education.

On the basis of Bandura's (1997) conceptualization of self-efficacy as an individual judgment of one's capabilities to plan and enact specific tasks, Klassen and Tze (2014) argued that the construct should be aligned with specific task demands and requirements. More precisely, teachers' capabilities to use computers in different settings and for different purposes should be taken into account in describing their computer self-efficacy (CSE). For this reason, one may propose a number of operational skills for using computers on the one hand, and skills that refer to instructional capabilities for using computers on the other hand (Lee & Lee, 2014; Sieverding & Koch, 2009). Given the variety of skills associated with computer self-efficacy in educational contexts, a multidimensional perspective of self-efficacy is therefore indicated (Teo & Koh, 2010). In fact, differentiating between specific factors of self-efficacy can provide more detailed information about the levels of teachers' self-beliefs than information about whether teachers' general self-efficacy is high or low (see also Skaalvik & Skaalvik, 2007 for a general discussion on the dimensionality of teachers' self-efficacy). Such a differentiation becomes particularly informative in group comparisons with respect to the specific CSE factors.

Specifically, researchers in the field of the integration and acceptance of information and communication technologies (ICT) are concerned with differences in constructs such as computer self-efficacy across the gender groups (Huffman, Whetten, &

* Corresponding author at: University of Oslo, Faculty of Educational Sciences, Centre for Educational Measurement at the University of Oslo (CEMO), Postbox 1161 Blindern, 0318 Oslo, Norway.
E-mail address: ronny.scherer@cemo.uio.no (R. Scherer).

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Huffman, 2013; Sang, Valcke, van Braak, & Tondeur, 2010; Shashaani, 1993; Sieverding & Koch, 2009; Teo, 2008). Until now, comparisons among female and male teachers' computer self-efficacy were rarely based on a multidimensional perspective of the construct. In addition, only few researchers who studied gender differences in CSE by using unidimensional measurements investigated whether the measurements are comparable for the gender groups (e.g., Teo, 2014). This state is somehow unexpected because researchers need to ensure that the group differences are not biased by the differential functioning of the CSE measurement for females and males. Moreover, establishing invariant measures becomes particularly important when reporting the effects of CSE interventions, which may differ across gender (Ong & Lai, 2006).

In light of these considerations, we evaluate a multidimensional measurement of teachers' CSE. By means of multi-group confirmatory factor analysis we test the factor structure of CSE for invariance across gender. If sufficient levels of invariance are to be established, mean comparisons in CSE will be conducted. Moreover, we report the effects of participating in computer-related professional development courses on CSE for female and male teachers.

2. Theoretical framework

2.1. Conceptualization and measurement of teachers' computer self-efficacy

Bandura (1997) defined self-efficacy beliefs on the basis of social cognition theory as individuals' perceptions of their capabilities to plan and execute specific behavior, which is required to attain designated types of performance. In this respect, self-efficacy can be considered a personal belief about what a person *can do* rather than about what a person *will do* (Bong & Skaalvik, 2003). Henceforth, it determines persons' actions, goals, and the effort taken in performing tasks (Skaalvik & Skaalvik, 2007, 2010). It is noteworthy that self-efficacy beliefs are self-referent, that is, they refer to subjective evaluations of a person's capabilities, although they are formed and affected by external factors and prior experience (Bandura, 1997; Usher & Pajares, 2008). In other words, people who experience the same environment may show different self-efficacies. Based on these general considerations of self-efficacy, research has conceptualized *teachers' self-efficacy* as teachers' beliefs in their capabilities to influence students' achievement, motivation, and interest in classroom settings (Klassen & Tze, 2014). Tschannen-Moran and Woolfolk Hoy (2001) further emphasized that these beliefs are context-specific and linked to instructional tasks. Consequently, researchers have established multidimensional measures of teachers' self-efficacy, which assess the construct with respect to classroom management, student engagement, and general instruction; thus stressing the importance of the specific teaching practices in classrooms (Skaalvik & Skaalvik, 2010; Tschannen-Moran & Woolfolk Hoy, 2001).

Following Bandura's (1997) conceptualization of self-efficacy, Compeau and Higgins (1995) defined *computer self-efficacy* as "a judgment of one's capability to use a computer" (p. 192). Instead of referring to "simple component subskills, like [...] entering formulas in a spreadsheet", the construct "incorporates judgments of the ability to apply those skills to broader tasks" (p. 192). Hence, in line with Bong and Skaalvik (2003), the measurement of computer self-efficacy is oriented toward perceptions of the confidence in performing specific tasks. Building on this definition, existing research provides evidence on the importance of *teachers' computer self-efficacy (CSE)* for their adoption of computers in teaching and learning situations (Govender & Govender, 2009), their intention to use computers (Sang et al., 2010), their technology acceptance (Teo, 2014), and students' learning outcomes (Moos & Azevedo, 2009). Smarkola (2008) has therefore proposed to consider CSE a component of perceived behavioral control, directly affecting behavioral intention and usage behavior. In fact, empirical studies on the relations among CSE, perceived usefulness, perceived ease of use, and the intention to use computers revealed direct effects of CSE on the intention to use computers, stressing the predictive power of the construct for integrating information and communication technology (ICT) into classrooms (Gong, Xu, & Yu, 2004; Teo, 2008, 2009).

Looking at the measurement of CSE, Ortiz de Guinea and Webster (2011) emphasized the need for multidimensional assessments, capturing teacher beliefs in different kinds of computer skills. Although multidimensional assessments have become common in research on teachers' *general* self-efficacy (Skaalvik & Skaalvik, 2010; Tschannen-Moran & Woolfolk Hoy, 2001), it is surprising that CSE has mostly been measured by a limited number of items that capture a unidimensional trait (e.g., Durndell & Haag, 2002; Govender & Govender, 2009; Imhof, Vollmeyer, & Beierlein, 2007; Teo, 2014, 2015). Particularly since computer skills are conceptualized as multifaceted constructs (in the form of digital literacy; e.g., Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014), the need for assessing different factors of CSE is indicated. Attempting to address this need, few researchers proposed multidimensional assessments and distinguished between a number of operational computer skills (e.g., Paraskeva, Bouta, & Papagianna, 2008; Teo & Koh, 2010). On the contrary, Wong et al. (2012) suggested looking at the instructional components of CSE measures beyond mere operational skills. This suggestion is in line with the previously described research on teachers' self-efficacy and points to the different demands teachers face in using computers in 21st century classrooms.

We conclude from our literature review that there is a need for multidimensional assessments of CSE that do not only capture operational computer skills but instructional capabilities.

2.2. Gender differences in teachers' computer self-efficacy

In light of the ongoing discussions about gender gaps with respect to attitudes, experience, and skills in the context of ICT (Cooper, 2006; Plumm, 2008), it is of particular interest to identify potential gender differences in teachers' beliefs, as they may determine teachers' intention to use and the actual integration of ICT into classrooms differentially (Ong & Lai, 2006; Teo, 2014; Tondeur, Valcke, & van Braak, 2008). The body of existing research abounds with conflicting results on the gender differences with respect to computer self-efficacy, emphasizing the need for reconsidering the impact of gender on CSE (Sang et al., 2010; Teo, 2008).

Apparently, there is evidence that female teachers tend to regard themselves as less proficient in using computers than male teachers, although their competencies may be comparable (Durndell & Haag, 2002; Shashaani, 1993; Sieverding & Koch, 2009). These differences in self-beliefs lead to differences in ICT integration. For instance, in the context of technology acceptance, Ong and Lai (2006) studied teachers' ratings of constructs such as perceived ease of use, perceived usefulness, and intentions to use computers along with their CSE. They found that gender moderates some of the relations between these constructs. In this regard, women's intentions to use computers were more strongly affected by their CSE and perceived ease of use than men. Other researchers were able to support this finding and pointed to significant differences in the perceived ease of use construct (Teo, 2014; Wong et al., 2012; Yuen & Ma, 2002). But not only the way in which

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