



## Full length article

## Accuracy and bias of ICT self-efficacy: An empirical study into students' over- and underestimation of their ICT competences

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## ABSTRACT

Most studies on the assessment of ICT competences use measures of ICT self-efficacy. These studies are often accused that they suffer from self-reported bias, i.e. students can over- and/or underestimate their ICT competences. As such, taking bias and accuracy of ICT self-efficacy into account, would improve the validity of these studies and the predictive power of the ICT self-efficacy measures used. Consequently, the general aim of this study is twofold. First, to explore the degree to which primary school students are under- and/or overestimating their ability in digital information processing and communication. Second, to identify student characteristics that are possibly related to the accuracy of ICT self-efficacy. Information on accuracy and bias of ICT self-efficacy was gathered by comparing students' results on an ICT self-efficacy scale and a performance based ICT competence test. Both instruments were administered to 378 sixth grade students from 58 primary schools in Flanders (the Dutch speaking part of Belgium). Information on the explanatory student characteristics was gathered through a questionnaire that was administered to the same students. The results indicate that primary school students make relatively accurate and positively biased judgments about their ability in digital information processing and communication. Further, the results indicate that primary school students' actual ICT competences and previous ICT experience are related to their accuracy of ICT self-efficacy. As this study is one of the first to investigate primary school students' accuracy and bias of ICT self-efficacy and to identify potential explanatory variables, it provides new insights into the nature of ICT self-efficacy.

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## 1. Introduction

In general, ICT self-efficacy comprises computer and Internet self-efficacy (Papastergiou, 2010) and is defined as a person's judgment regarding his or her ability in using the computer and the Internet (Papastergiou, Gerodimos, & Antoniou, 2011; Torkzadeh, Chang, & Demirhan, 2006). In most research, ICT self-efficacy is operationalized as a measure of strength. Similar to other types of self-efficacy strength such as math self-efficacy strength (Chen, 2003), ICT self-efficacy strength refers to the level or extent of one's belief of using the computer and the Internet. As such, ICT self-efficacy strength can vary from low levels (weak belief) to high levels (strong belief). The relation between variation in strength of ICT self-efficacy and regulation of students' emotions, choices, and courses of actions towards using ICT, as well as the determination of

their actual ICT competences, has been intensively acknowledged in the research literature (Aesaert, Van Nijlen, Vanderlinde, Tondeur, Devlieger and van Braak, 2015; Barbeite & Weiss, 2004; Sam, Othman, & Nordin, 2005; Sun, 2008). These studies succinctly indicate the importance of elevating students' level of ICT self-efficacy in order to develop their ICT competences and improve their use and feelings towards ICT. For example, results of Tsai and Tsai (2003) revealed that students with higher ICT self-efficacy tend to have better online information processing strategies. Aesaert et al. (2015) found that primary school students' ICT self-efficacy is positively related to their actual competence in locating and processing digital information, and communicating using a computer. Similarly, results of the international ICILS 2013 study indicate that the higher students' basic ICT self-efficacy, the higher their computer and information literacy (Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014). Further, ICT self-efficacy is positively related to perceived ease of use and perceived usefulness of technology, and to behavioral intention to use technology (Aesaert et al., 2015; Courtois et al., 2014; Ong & Lai, 2006). A study of

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Wilfong (2006) indicates that ICT self-efficacy has a strong negative association with students' feelings of anger and anxiety towards computer use. Moreover, students with higher level of ICT self-efficacy use the Internet more often, and seem to have a higher level of specific types of ICT use such as leisure and educational use (Durndell & Haag, 2002; Rohatgi, Scherer, & Hatlevik, 2016; Tømte & Hatlevik, 2011).

Although the strength of students' ICT self-efficacy is important for good performance in ICT related tasks, the bias and accuracy of students' ICT self-efficacy are equally important. While bias indicates whether one is over- or underestimating his ability, accuracy refers to the extent to which the over- or underestimation is big or small (Pajares & Graham, 1999). In the context of self-efficacy in general, successful performance is stimulated by accurate self-efficacy, and the most stimulating self-efficacy judgments are those that slightly surpass one's actual competence, as slight overestimation increases consistency and efforts being made (Bandura, 1986; Pajares, 1997). Research that has focused on other types of self-efficacy such as mathematics self-efficacy (Chen, 2003) indicates that it is important that students' self-efficacy is accurate and free of bias. Zimmerman, Bonner, and Kovach (1996) reported that students who highly overestimate their ability, are not likely to change their study methods. In this context, Cleary (2009) states that inflated self-efficacy judgments, i.e., high overestimation, are problematic as they might obscure the student's perception about the effort required to make the task, or the perception of needing support to complete a task. With regard to ICT self-efficacy and ICT competences, consider for example, a student who enters entire phrases as a search query in a search engine. Considering the searching-method used, there is a high probability that the student's online searching ability is not very high and that he will not retrieve the required information in an efficient way. However, if the student overestimates his searching ability too much, this could mean he will not easily change his searching-method or ask a peer, parent or teacher for help, resulting in entering entire phrases in the search engine over and over again.

Further, research indicates that bias and accuracy of self-efficacy need to be considered when studying the relationship between self-efficacy and actual performance (Pajares & Miller, 1997). Chen (2003) found that adding accuracy of self-efficacy to self-efficacy strength (from low to high), improved the predictions of actual mathematical performance by 40%. Many studies on the assessment of ICT competences, use measures of ICT self-efficacy to assess students' actual level of ICT competence. These studies are often accused that they suffer from self-reported bias related to measures of ICT self-efficacy. As such, taking bias and accuracy of ICT self-efficacy into account, would improve the validity of these studies and the predictive power of the ICT self-efficacy measures used.

Taking into account that successful performance is stimulated by accurate self-efficacy (Bandura, 1986) and considering, to our knowledge, that bias and accuracy of ICT self-efficacy have not yet been studied, the general aim of this study is twofold. The first aim is to explore the degree to which primary school students over- and/or underestimate their ICT competences, using a bias and accuracy measure of ICT self-efficacy. The study sample contains primary school students as especially younger children seem to have self-perceived competences that do not reflect their actual ability (Bouffard, Markovits, Vezeau, Boisvert, & Dumas, 1994).

The second aim is to identify student characteristics that are assumed to affect primary school students' accuracy of ICT self-efficacy. For the second aim, this study focuses on student characteristics that affect the accuracy of ICT self-efficacy rather than the bias of ICT self-efficacy, as it is especially the magnitude of the bias (i.e. accuracy) that stimulates successful performance. Moreover,

there has been a widespread call in the research literature to investigate factors that affect the accuracy of self-efficacy and self-assessments (Dupeyrat, Escribe, Huet, & Régner, 2011).

## 2. Research literature

### 2.1. ICT self-efficacy

ICT self-efficacy can be considered as a construct that is involved in the regulation of students' daily activities and interactions with computers and the Internet. The concept originates from the construct of self-efficacy, which is derived from Bandura's Social Cognitive Theory. According to Bandura (1986), self-efficacy is concerned with "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (p.391), i.e. people's judgment about, or belief in their abilities to successfully perform a certain behavior. Self-efficacy beliefs cannot be considered as a single trait. Rather, people's sense of personal efficacy consists of a differentiated set of beliefs that are related to distinct areas of functioning and activities (Bandura, 2006, pp. 307–338). This differentiated approach to self-efficacy has been reflected in educational research, as several domain-specific measures of self-efficacy have been developed in a variety of academic subject areas such as mathematical self-efficacy, writing self-efficacy and also ICT self-efficacy (Moos & Azevedo, 2009; Pajares, 1997; Pajares, Miller, & Johnson, 1999; Tsai & Tsai, 2010).

In general, ICT self-efficacy comprises two related domains of beliefs of ICT related abilities i.e. computer and Internet self-efficacy (Papastergiou, 2010). Focusing on self-efficacy with respect to using computers in general, Compeau and Higgins (1995) initially defined computer self-efficacy as "*an individual's perception of his or her ability to use a computer in the accomplishment of a job task*" (p.193). In the past two decades, this initial definition of general computer self-efficacy has repeatedly been adapted and modified by several researchers. Following Bandura's notion that self-efficacy is not a single trait, but varies across activities and situational circumstances, Marakas, Yi, and Johnson (1998) made a distinction between general computer self-efficacy and task-specific self-efficacy. Whereas general computer self-efficacy refers to a person's judgment of his ability to use a computer across multiple computer application domains, task specific computer self-efficacy is about one's judgment of his ability to successfully complete computer-related tasks in the domain of general computing (Agarwal, Sambamurthy, & Stair, 2000). At the dawn of the new millennium, researchers stressed that the early computer self-efficacy concepts and scales predated the importance of Internet related skills, and that studies on Internet self-efficacy were needed (Torkzadeh & Van Dyke, 2002). Several researchers have conceptualized Internet self-efficacy as an individual's beliefs about his ability to successfully perform tasks and achieve goals using the Internet (Sun, 2008). Similar to the studies on computer self-efficacy, researchers have used general as well as task or activity specific concepts of Internet self-efficacy. For example, Liang and Tsai (2008) made a distinction between general and communicative self-efficacy, referring to students' perceived beliefs in using the Internet in general and their beliefs for Internet-based interaction and communication respectively. Focusing solely on specific concepts of Internet self-efficacy, Tsai and Tsai (2010) made a distinction between students' perceived ability 1) to navigate and search information on the Internet (online exploration), and 2) to communicate using the Internet (online communication). Papastergiou et al. (2011) defined Internet self-efficacy as an individual's beliefs about his ability to use the Internet and multimedia blogging.

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