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Exploring factors related to primary school pupils' ICT self-efficacy: A multilevel approach

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ABSTRACT

The aim of this study was to identify factors that are related to pupils' ICT self-efficacy. More specifically, a multilayered framework was used to identify which pupil, classroom and school level factors are associated with primary school pupils' self-perceived competence in digital information processing and communication. Information on pupils' ICT self-efficacy and the pupil level factors was gathered through a questionnaire administered to 2421 sixth grade pupils (and their parents) in 92 Flemish primary schools. A questionnaire was also administered to the teachers ($n = 141$) and the schools' ICT coordinators ($n = 86$) in order to gather information on classroom and school level factors. The results of the multilevel analysis indicate that ICT self-efficacy can be considered as a pupil, rather than a class or school, phenomenon. The results indicate that the pupil level factors ICT experience, ICT attitude, parental ICT attitude, controlling learning style, analytic intelligence and amotivation, are related to primary school pupils' ICT self-efficacy.

1. Introduction

In the last decades, computers and the internet have increasingly permeated virtually all aspects of our daily lives. As our contemporary information and knowledge society depends more and more on information technology, people must possess a set of ICT competences and skills to cope with associated educational, social and economic challenges (Kozma, 2008; Sieverding & Koch, 2009). In terms of education, research stresses the potential of computer and internet based learning environments to foster students' learning (Moos & Azevedo, 2009; Tsai, Chuang, Liang, & Tsai, 2011). In order to profit from the learning benefits of computer and internet based learning environments, pupils must master ICT skills and competences. Research focusing on factors associated with students' ICT competences indicates that their perception of their own ICT-abilities i.e. their ICT self-efficacy, is positively related to computer and internet use and performance (Barbeite & Weiss, 2004; Sam, Othman, & Nordin, 2005; Torkzadeh, Chang, & Demirhan, 2006). ICT self-efficacy is rooted in Bandura's broader concept of self-efficacy, which generally refers to a person's belief in his capability to successfully perform a certain task (Marakas, Yi, & Johnson, 1998). With regard to the relationship between pupils' ICT competences and their belief to perform ICT related tasks (i.e. ICT self-efficacy), pupils with high internet self-efficacy tend to have better information-searching strategies, which, in turn might explain why these students tend to learn better in web-based learning tasks (Tsai & Tsai, 2003). Furthermore, Johnson (2005) indicates that application specific computer self-efficacy is positively related to data task performance. The author describes this relationship between computer self-efficacy and actual computer performance as reciprocal; it is mediated and reinforced by successful task experiences.

Aside from the relation between ICT self-efficacy and actual ICT competences, research has also focused on ICT self-efficacy in terms of a more motivational and attitudinal point of view. Individuals with higher computer self-efficacy have a greater penchant for technology, exhibit more frequent use of computers, and have lower anxiety around technology (Chou, 2001; Compeau & Higgins, 1995; Wilfong, 2006). More recently, in the context of technology acceptance research, studies indicate that an individual's computer self-efficacy has a strong effect on behavioral intention to use technology, perceived ease of use and perceived usefulness of the technology (Gong, Xu, & Yu, 2004; Ong & Lai, 2006; Teo, 2009; Venkatesh, Morris, Davis, & Davis, 2003). These data not only stress the importance of stimulating pupils' ICT self-efficacy, such that their ICT competences and general acceptance of technology can be enhanced, the data also illustrate belief in the overall importance of this kind of research. Nevertheless, there remains a dearth of research into factors related to ICT

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self-efficacy (i.e. the factors that possibly foster or hamper pupils' judgment of their own ICT competences). Indeed, research that has investigated such factors appears to have been mostly conducted in post-primary schools and from a single-level perspective (Aesaert, Van Nijlen, Vanderlinde, & van Braak, 2014). These single-level studies do not take into account the complexity of the educational context in which pupils interact (i.e. pupils nested in classrooms, which are in turn nested in schools). In other words, these studies treat pupils as if they are independent of the classroom and school to which they belong and wrongly assume that pupils do not share common characteristics. Ignoring the variability that likely exists at each of the said levels may lead to erroneous regression coefficients and standard errors (Creemers & Kyriakides, 2008; Snijders & Bosker, 2012). As such, the aim of this study is to use a multilevel approach in order to identify pupil, class and school level factors that might be associated with primary school pupils' ICT self-efficacy. In this study, ICT self-efficacy is considered as a self-perceived measure of pupils' ICT competence (i.e. pupils own assessment of successfully performing computer- and internet-based tasks (Meelissen, 2008). It is operationalized as self-perceived competence in digital information processing and communication. Pupil, class and school level factors are derived from the EDC-model (Aesaert, Vanderlinde, Van Nijlen, & van Braak, submitted for publication).

2. Theoretical background

2.1. ICT self-efficacy

ICT self-efficacy originates from the concept of self-efficacy, derived from Bandura's Social Cognitive Theory. Bandura (1986) defines self-efficacy as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (p. 391), i.e., a person's belief in or expectation of his/her ability to successfully perform a certain behavior. Over the years, pupils' self-efficacy has been studied in a variety of academic subject areas, producing a range of domain-specific measures of self-efficacy, such as mathematical self-efficacy, reading self-efficacy and ICT self-efficacy (Baker & Wigfield, 1999; Moos & Azevedo, 2009; Pajares & Miller, 1994; Tsai et al., 2011). As research indicates that domain-specific measures of self-efficacy deliver more accurate predictions for performance than general measures (Saleem, Beaudry, & Croteau, 2011), the use of ICT self-efficacy measures is preferred over the use of general efficacy measures.

In general, ICT self-efficacy comprises computer self-efficacy and internet self-efficacy (Papastergiou, 2010). For Compeau and Higgins (1995) computer self-efficacy is the individual's judgment of his/her ability to apply computer skills to broader tasks in the future. Through the years, this initial definition of computer self-efficacy has been frequently adapted and modified. Marakas et al. (1998) define computer self-efficacy as an individual's belief in his or her ability to perform specific computer tasks. The authors divide computer-self efficacy into two parts: general computer self-efficacy and task-specific self-efficacy. Whereas general computer self-efficacy refers to the person's judgment of his/her capabilities in multiple computer application domains, task-specific computer self-efficacy concerns the perception of successfully completing computer-specific tasks in the domain of general computing (Agarwal, Sambamurthy, & Stair, 2000; Marakas et al., 1998). In this context, general computer self-efficacy is often considered more important than competence in specific ICT applications, given that pupils with high computer self-efficacy can more easily adapt to continuously changing technological applications and environments (Papastergiou, 2010; Sam et al., 2005). Next to computer self-efficacy, ICT self-efficacy includes Internet self-efficacy. Similar to computer self-efficacy, internet self-efficacy is often defined as a person's belief in his/her ability to use the internet to accomplish certain goals (Sun, 2008). For example, Papastergiou, Gerodimos, and Antoniou (2011) perceive internet self-efficacy as students' individual beliefs regarding their ability to use the internet and multimedia blogging. Liang and Tsai (2008) divide internet self-efficacy into general internet self-efficacy (GISE) and communicative internet self-efficacy (CISE). Whereas GISE refers to the self-perceived competence in using the internet in general, CISE addresses students' competence for Internet-based interaction and communication. Similarly, Tsai and Tsai (2010) use a less general definition and operationalize internet self-efficacy as the perceived ability to (1) navigate and search for information on the internet (online exploration), and (2) communicate via the internet (online communication). Torkzadeh and Van Dyke (2002) developed an instrument in which Internet self-efficacy is defined in terms of browsing, encryption/decryption, and system manipulation.

In this study ICT self-efficacy refers to pupils' judgment of their ability to process digital information and to communicate with others by using a computer and the internet. More specifically, it concerns the intensity of a pupil's belief in his ability to successfully perform specific digital tasks with regard to (1) retrieving and processing appropriate digital information; and (2) communicating in a safe, sensible and appropriate way. Research indicates that pupils still experience difficulties with information retrieval and processing, such as defining search queries, evaluating online information; and with online communication skills (Kuiper, Volman, & Terwel, 2005; Van Deursen & Van Diepen, 2013). Moreover both themes of digital communication and information processing are identified as two essential competences that pupils should possess in national and international ICT curricula (Aesaert, Vanderlinde, Tondeur, & van Braak, 2013; Voogt & Roblin, 2012). As ICT self-efficacy strongly affects ICT competences, it is important to identify factors that are related to pupils' ICT self-efficacy on both sides. Because digital communication as well as retrieving and processing digital information is not solely done by means of the Internet but also by using ICT skills in stand-alone software, such as a text processing programs, ICT self-efficacy is preferred over the concept of internet self-efficacy.

2.2. Factors related to self-perceived measures of ICT-competences

Below we review the empirical literature grounding the importance of the variables integrated in the EDC-model (Aesaert et al., submitted for publication), used as a reference framework for setting up this study (see Fig. 1). The dependent variable, ICT competence, is integrated in the model as both a direct and an indirect measure. Whereas the direct measure refers to pupils' actual ICT competences, the indirect measure refers to self-perceived ICT competence (i.e. ICT self-efficacy). In the model, ICT competence is perceived as a higher-order learning-process skill that children use to solve problems in a digital context, underpinned by technical and application skills. These latter (basic) ICT-skills are considered to be instrumental to the former higher-order learning-processing skills. This study focuses only on ICT self-efficacy as the dependent variable of the model and not on the direct measure of ICT competences. The independent variables of the model refer to school level, classroom level and pupil level factors that might be related to primary school pupils' actual and perceived ICT competences.

2.2.1. Pupil level factors

2.2.1.1. ICT related pupil characteristics. In the literature, a range of ICT related pupil characteristics can be found that are expected to