Teachers' emphasis on developing students' digital information and communication skills (TEDDICS): A new construct in 21st century education

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ABSTRACT

The main aim of this study is to validate an instrument to measure teachers' emphasis on the development of students' digital information and communication skills (TEDDICS), a construct that describes a qualitative aspect of ICT use beyond mere frequency reports. TEDDICS was conceptualized by focusing on digital skills such as accessing, evaluating, and sharing and communicating digital information. We validated TEDDICS with respect to its factorial structure, relations to further teacher-related variables (e.g., ICT self-efficacy), background characteristics (age and gender), and main subject differences. The Norwegian International Computer and Information Literacy Study (ICILS) 2013 teacher sample ($N = 1072$) showed that TEDDICS: (a) comprises three factors which can be identified by exploratory structural equation modeling (ESEM); (b) is positively related to ICT self-efficacy, the frequency of ICT use, and perceived usefulness of ICT; (c) differs across main subjects but not across gender groups. In addressing our research aims, we show that ESEM represents TEDDICS more appropriately than confirmatory factor analysis. Our results provide strong evidence on the construct validity and point out to the importance of looking at the degree to which teachers emphasize digital skills in classrooms beyond the frequency of using ICT.

1. Introduction

Students' digital information and communication skills have gained substantial attention during the last decade and are regarded as important skills in the 21st century (Griffin, Care, & McGaw, 2012). These skills refer to several aspects related to knowledge, beliefs, attitudes, and values concerning information and communication technology (ICT), covering a variety of contexts and new technologies (Ferrari, 2013). New technologies have made searching for and accessing information easy and available for everybody. However, since the Internet offers opportunities for everyone to publish independently of the quality of the information dispatched, it is essential for students to develop skills to deal with digital information (Ferrari, 2013). In a recent study, Strømsø and Bråten (2014) argued that undergraduates need more training in sourcing and evaluating digital

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information. These skills are of particular importance, because they are beyond mere information search. In fact, evaluating information and using it in order to solve tasks, present the results, and collaborate with others are regarded as crucial competencies students are supposed to acquire (Griffin, Care, & McGraw, 2012; Pellegrino & Hilton, 2012). Moreover, these skills are crucial for adults in order to fulfill the working demands in the 21st century (OECD, 2013).

In order to provide opportunities to acquire these skills, teachers and schools are expected to integrate ICT into their classroom practice (Schibeci et al., 2008; Tondeur, van Keer, van Braak, & Valcke, 2008). Consequently, research has focused on the factors determining especially teachers' ICT integration (Donnelly, McGarr, & O'Reilly, 2011). Among these factors, self-efficacy, perceived usefulness, perceived ease of use, teaching beliefs, ICT anxiety, and general attitudes towards computers have been identified as relevant determinants (e.g., Compeau, Higgins, & Huff, 1999; Igbaria, Parasuraman, & Baroudi, 1996; Mac Callum, Jeffrey, & Kinshuk, 2014; Sang, Valcke, Braak, & Tondeur, 2010; Teo, 2011; Tondeur, Valcke, & van Braak, 2008). But these factors of ICT integration mainly refer to teachers' perceptions of their ICT skills and the usefulness of integrating ICT in teaching and learning. Although there is a trend of shifting research beyond these perceptions (e.g., 'technological pedagogical content knowledge'; Voogt, Fisser, Roblin, Tondeur, & van Braak, 2012), it is surprising that a detailed view on how teachers actually emphasize the development of students' digital information and communication skills in classrooms is lacking.

Teachers' emphasis on developing students' digital information and communication skills (TEDDICS) differs from the factors mentioned earlier, because it does not refer to personal beliefs or the use of ICT regarding its quantity or technology specificity (e.g., Which kinds of ICT tools and software are used?). Instead, TEDDICS is a goal-oriented construct that combines the use of ICT, teaching practice, curricular demands, and beliefs about which ICT skills are important. In fact, following Schmid, Bernard et al.'s (2014) plea for shifting research "toward a more fine-grained analysis of identified instructional factors" (p. 286), studying TEDDICS provides valuable information on the link between students' digital skills and teachers' classroom practice.

Against this background, the present study is aimed at investigating TEDDICS, a newly studied construct, with respect to its validity. On the basis of the Norwegian International Computer and Information Literacy Study (ICILS) 2013 sample, we approach (a) the factorial structure; (b) the relations to other constructs; and (c) differences across gender and main subject groups by using exploratory structural equation modeling. We sought to gather evidence on different aspects of construct validity (AERA, APA, & NCME, 2014; Messick, 1995).

2. Theoretical framework

2.1. Students' digital information and communication skills

Students' digital competence has been described in a number of frameworks, comprising many dimensions and aspects (Ferrari, 2012; Voogt et al., 2012). For instance, Ferrari (2013) proposes five different areas for which a number of essential competences are described. One of these areas is concerned with the aspects of dealing with digital information, which are considered important skills in the 21st century (Griffin et al., 2012; Strømsø & Bråten, 2014). Regarding this competence area, most of the frameworks distinguish between search, evaluation, and communication processes (Calvani, Cartelli, Fini, & Ranieri, 2009; Ferrari, 2013; Fraillon, Schulz, & Ainley, 2013; International ICT Literacy Panel, 2007). In addition, research on the operationalization of *digital information skills* tends to keep this distinction and indicates that students lack these skills and experience problems related to information retrieval and processing skills (e.g., defining proper search queries, evaluating information, presenting and communicating information in non-structured digital environments; Aesaert, van Nijlen, Vanderlinde, & van Braak, 2014; Calvani, Fini, Ranieri, & Picci, 2012; Kuiper, Volman, & Terwel, 2005). In sum, distinguishing between the different skills involved in mastering digital information (i.e., accessing, evaluating, sharing and communicating; e.g., Ferrari, 2013) may provide a conceptual framework for describing teachers' emphasis on the development of these skills in their classrooms.

2.2. Teachers' emphasis on developing students' digital information and communication skills (TEDDICS)

In light of the considerations on the multiple dimensions of students' digital information and communication skills, the degree to which teachers emphasize fostering these skills in classrooms can be regarded as a multidimensional construct, describing a qualitative rather than a quantitative facet of ICT use (Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014). In fact, instead of looking at the frequency of using ICT, studying TEDDICS provides detailed information on the synergy between curricular demands and teachers' beliefs about the importance of digital skills, further linking it to the development of students' competence in this area (Fraillon et al., 2013).

Considering evidence drawn from empirical studies on the multidimensionality of digital information skills, we seize the factorial structure of the TEDDICS construct consisting of three factors: *Access digital information*, *Evaluate digital information*, and *Share and communicate digital information*. Although these three factors are conceptually distinct, they may overlap because they refer to the same overall concept concerning digital information. Additionally, they may represent a sequence of processes: For instance, when sharing information students need to filter it beforehand. Further, the evaluation process follows the search for digital information. Hence, the three factors appear interwoven, leading to a construct overlap that