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Development and validation of the ICT motivation scale for young adolescents. Results of the international school assessment study ICILS 2013 in Germany

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ABSTRACT

Although motivational factors play an important role in the development of information and communication technologies (ICT) literacy, only few of the studies that have assessed ICT literacy have also presented a theoretically derived conceptualization of ICT motivation. To address this issue, we examined the psychometric properties of a newly developed ICT motivation scale which distinguishes between several incentives to use ICT. Using the data from the International Computer and Information Literacy Study (ICILS) 2013, confirmatory analysis confirmed the hypothesized higher-order factor structure and at least metric measurement invariance with regard to gender and social background. The scale showed convergent and discriminant validity with ICT behavior, ICT literacy and social background variables. Furthermore, it incrementally predicted ICT literacy over and above intelligence and general interest in ICT.

1. Introduction

The ability to effectively use information and communication technologies (ICT) is becoming increasingly important in people's everyday lives to successfully solve everyday tasks and problems. ICT literacy also plays an important role in many educational and workplace settings (e.g., Peng, 2017). Thus, ICT literacy is a key or meta competence necessary for successful participation in society (e.g. European Commission, 2008; Fraillon, Schulz, & Ainley, 2013). More recent conceptualizations of ICT literacy integrate technological and cognitive aspects to define ICT literacy. For instance, one widely used definition describes ICT literacy as "using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society" (ETS, 2002, p. 16). Accordingly, to solve information-related tasks (e.g., searching for trustworthy information on the internet) technical knowledge as well as cognitive skills (e.g., problem-solving skills) are required (e.g., Walraven, Brand-Gruwel, & Boshuizen, 2008).

Because of the rapidly changing technological environment, self-regulated and continuous life-long learning is a key factor for successfully keeping pace with recent developments in the area of ICT (e.g., European Commission, 2008). This is a crucial aspect for young people, because they use ICT more often at home than at school and most of them further develop ICT knowledge and skills on their own and in a self-directed way (Wittwer & Senkbeil, 2008; Zhong, 2011). Against this background, motivational factors play an important role in developing ICT literacy (e.g., Naumann & Sälzer, 2017; Zylka, Christoph, Kröhne, Hartig, & Goldhammer, 2015), but only a few studies have assessed individual differences in ICT literacy and also measured motivations to use ICT or present a theoretically derived conceptualization of ICT motivation (e.g., Zylka et al., 2015).

In this paper, we describe the development and validation of a motivation scale which tries to overcome these difficulties by drawing on a social cognitive theory-based approach which differentiates between specific types of motivations to use ICT (e.g., instrumental or social incentives; LaRose, Mastro, & Eastin, 2001). First, we explicate and test our hypotheses about the psychometric properties of the newly developed ICT motivation scale, i.e., we focus on the dimensionality of the scale and measurement invariance with regard to relevant person characteristics. Second, we investigate the relationships to ICT behavior, ICT literacy and social background variables. Third, we assess the incremental validity of the scale beyond intelligence and an alternative ICT motivation indicator (general interest in ICT). To answer these questions, we analyze data from the International Computer and Information Literacy Study (ICILS) 2013 in Germany.

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2. Theoretical background

2.1. Measuring motivations to use ICT and its relationship with ICT literacy

Though domain-specific interest and motivation have been shown to be weakly to moderately ($.20 \leq r \leq .30$) related with academic achievement and PISA competencies (Chiu & McBride-Chang, 2006; Kriegbaum, Jansen, & Spinath, 2015), this relationship does not seem to apply to ICT literacy. Some studies revealed only very small relationships between motivations to use ICT in general and ICT literacy or related constructs such as digital reading ($rs \leq .10$; Aesaert et al., 2015, Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014; OECD, 2011). A possible explanation for these unexpected results might be found in the way in which the motivations to use ICT was conceptualized and measured. Most conceptualizations are based on expectancy value theory (Wigfield & Eccles, 2000) and measure general interest in ICT, defined as students' enjoyment and positive evaluations of computer-related activities (e.g., games, social networks; Zylka et al., 2015). Thus, ICT motivation and attitude scales were unspecific with regard to different purposes of using ICT, such as information seeking, or social interaction (e.g., "I often look for new ways to do things using a computer"; Fraillon et al., 2014). Consequentially, when students make overall judgements on their motivations to use ICT, the kinds of usage experience they are referring to remains unclear (Petko, Cantieni, & Prasse, 2016).

On the other hand, several studies have shown that ICT literacy or related constructs such as digital reading are differentially correlated with ICT use for different purposes: ICT use for information-related and educational purposes (e.g. using an online dictionary) was positively and ICT use for social interaction purposes (e.g. chatting online) was negatively associated with ICT literacy or digital reading (e.g., Lee & Wu, 2013; Naumann, 2015). Most of these studies revealed weak to moderate relationships ($|.15| \leq r \leq |.30|$) between the different ICT activities and digital literacies.

As an explanation for these findings two overarching media orientations, based on users' motivations, can be distinguished: an instrumental orientation and a social interaction orientation (Kalmus, Realo, & Siibak, 2011; Metzger & Flanagin, 2002; Naumann, 2015). An instrumental orientation involves goal-directed motives such as information seeking, and learning. Information seeking activities (e.g. searching the internet for educational purposes) are associated with advanced metacognitive strategies such as monitoring, evaluating, and synthesizing information across webpages (e.g., Lee & Wu, 2013). For example, these activities "often require the student to carefully evaluate search results, to judge whether or not to follow the hyperlinks encountered, and to integrate the contents of the accessed documents into a coherent mental model" (Naumann, 2015, p. 264).

Conversely, a social interaction orientation involves motives such as interpersonal communication, impression management or social approval seeking (Krämer & Winter, 2008). Previous research has shown that, while using social online media, "students do not regularly cognitively engage in demanding tasks involving the thorough evaluation of hyperlinks as to their potential relevance for the task at hand. Thus, using social online media most likely does not result in developing the skills needed for task-adaptive navigation" (Naumann, 2015, p. 275). Moreover, social online media are often used in parallel to another task such as searching information for a school assignment (Kirschner & Karpinski, 2010). Since multitasking is bound to impair comprehension and learning (Sana, Weston, & Cepeda, 2013), social media heavy users were more likely to be distracted by online social activities (e.g. use of social network sites, reading E-mails).

Against this background, it may be promising to take specific types of motivations that correspond with information seeking, and social interaction activities into account in order to measure ICT-related motivations (e.g., Naumann, 2015; Petko et al., 2016). Thus, we relate our conceptualization of ICT motivation to a social cognitive theory-based approach which distinguishes between several incentives to use ICT (LaRose & Eastin, 2004).

2.2. Conceptualization of the ICT motivation scale

The conceptualization presented in this study, the ICT motivation scale, can be understood as an adaptation of the model of media attendance (MMA; LaRose & Eastin, 2004). The MMA focuses on predicting internet usage through motivational factors and is based on the social cognitive theory (SCT; Bandura, 1986). SCT proposes that behavior is largely determined by the expected outcomes, which are beliefs about contingent relations between successful task performance and received outcomes. These beliefs can be defined as judgments of the likely consequences of behavior and the values placed on those consequences (Bandura, 1999; see also e.g., Shell, Murphy, & Bruning, 1989). Within the MMA media usage is defined as overt media consumption and is largely determined by the expected outcomes that follow from media consumption (LaRose & Eastin, 2004). Since outcome expectations can operate anticipatorily as motivators of current behavior (Bandura, 2001), they represent motivational incentives to satisfy certain needs (so called ICT usage motives), such as information seeking, or social interaction (LaRose & Eastin, 2004).

Referring to Bandura's (1986) incentive categories the MMA distinguishes between six ICT usage motives with regard to internet use: *Information seeking*, *entertainment*, *escapism*, *social interaction*, *monetary incentives* in terms of benefit and profit when searching for information (e.g., saving time), and *self-presentational motives*. The ICT usage motives are general and relative stable dispositions that should affect ICT-related behavior also in the long-term. They are also valid indicators of digital media use, explaining > 30% of the variance of internet usage (e.g., Eastin, 2005; LaRose & Eastin, 2004).

According to the rapid development of ICT, we adapted the following aspects of the MMA for our own research (Senkbeil & Ihme, 2014, 2017): First, in contrast to the MMA, the ICT motivation scale refers not only to web-based applications but also to desktop applications such as word processing, spreadsheet, and presentation software. Second, we have removed monetary incentives, because they cannot be separated from information seeking empirically ($r = .97$; Peters, Rickes, Jöckel, van Crigern, & van Deursen, 2006). Instead, we added a *work- and learning related usage motive* (e.g., digital media as efficient tools for doing homework; Selwyn, 2008). Third, in accordance with previous research (e.g., Metzger & Flanagin, 2002; Naumann, 2015; see also Section 2.1) we conceptualized usage motives not as a general second-order factor, but assumed multiple underlying dimensions of this construct, namely an instrumental orientation and a social interaction orientation. With regard to internet-related studies involving younger populations, this classification was extended to include a hedonic orientation. It is not directed at any specific content and refers to media use for diversionary motives such as entertainment, relaxation, or escapism (e.g., Metzger & Flanagin, 2002). Previous research has shown that hedonic motives are uncorrelated with ICT Literacy (Senkbeil & Ihme, 2014, 2017).

3. Development of the ICT motivation scale

Following the classification scheme described above, we conceptualized the construct of ICT-related usage motives as a higher-order factor model with three second-order factors (instrumental, hedonic, and social interaction motive factor) and six first-order factors (usage motives: information seeking, entertainment, escapism, social exchange, self-presentation, learn and work). The usage motives *information seeking* and *learn and work* were assigned to the instrumental factor, the usage motives *entertainment* and *escapism* were assigned to the hedonic factor, and the usage motives *social exchange* and *self-presentation* were assigned to the social interaction factor (see also Fig. 1).

The scale was designed specifically to measure the ICT motivation of