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Adoption and use of technology in early education
The interplay of extrinsic barriers and teacher attitudes

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ABSTRACT

The increased access to, but continued under-use of, technology in education makes it imperative to understand the barriers teachers face when integrating technology into their classrooms. While prior research suggests teachers encounter both first-order extrinsic barriers and second-order personal barriers, much of this research has focused on K-12 teachers, not early childhood educators. Applying the Unified Theory of Acceptance and Use of Technology to early childhood education, the current study examines predictors of early childhood educators' access to and use of traditional technologies and newer mobile devices. Findings from 1329 teachers of 0–4-year-olds reveal that while extrinsic barriers influence access to a range of technologies, positive beliefs in children's learning from technology significantly predicted actual use of technology. Overall, the study provides new insight into factors influencing technology integration specifically for early childhood educators, a subgroup that has not been represented in much of the literature on technology integration in formal education.

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1. Introduction

Previous promises of a technological revolution in education have failed to produce much change (Buckingham, 2007). Despite increased access to computers and newer mobile devices, the actual use of technology in the classroom remains infrequent, especially in early childhood education (Wartella, Schomburg, Lauricella, Robb, & Flynn, 2010). While studies have explored how teacher beliefs and attitudes toward technology influence infrequent use (e.g., Ertmer, 1999; Ifenthaler & Schweinbenz, 2013; Pynoo et al., 2013; Wood, Specht, Willoughby, & Mueller, 2008), few large-scale quantitative analyses have been performed investigating teachers of young children, an important group given the current debate of the place of technology in the lives of children. Extending the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh, Morris, Davis, & Davis, 2003) to an education setting, the current study draws on surveys from 1329 early childhood educators to explore how school environment and personal attitudes toward the affordances and barriers of technology integration predicted use of various devices, including both universally available technologies (i.e., TV/DVD, computer, digital cameras) and newer mobile technologies (i.e., iPod/MP3 players, iPod touch devices, e-readers, tablet computers).

1.1. Technology in education

Despite general resistance to using technology, in-school computer access is now relatively universal (Gray, Thomas, & Lewis, 2010). In a national 2009 survey of 3150 teachers, 97% of teachers reported access to computers, with 96% of computers in schools having Internet access (Gray et al., 2010). While computers were once thought of as the silver bullet to education reform, the technology itself has done little to alter the education landscape or to provide enhanced outcomes for students. This may be due to the continued under-use of technology in

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the classroom across all grade levels (National Education Association, 2008) and the failure to use technology for instructional purposes (Gray et al., 2010). This is even more pronounced in the early education settings. While 55% of in-home care providers and 59% of classroom teachers report access to computers, 34% and 35% of educators, respectively, report never using a computer with young children in their childcare (Wartella et al., 2010).

1.2. Unified Theory of Acceptance and Use of Technology

Venkatesh et al. (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT) to explain what encourages people to accept and use technology in the workplace. Venkatesh et al. (2003) posited four major constructs that influence acceptance and use of technology: *performance expectancy*, which describes how much users believe the technology will aid them in their work; *effort expectancy*, or the perceived ease of using the technology; *social influence*, which describes subjective norms relating to technology use within the social environment; and *facilitating conditions*, or the structural features of the environment, such as training, support, and access to technology. In addition to these, the UTAUT posits four individual factors that moderate the relationship between the four main constructs and actual use. These include the user's age, gender, and prior experience with technology, as well as whether or not using technology in the workplace is voluntary. Overall, the UTAUT has been shown to explain 70% of the variance in behavioral intentions for using technology (Venkatesh et al., 2003).

While the UTAUT provides a sound theoretical basis for explaining how people adopt and use technology, few studies have applied it to an education environment. To provide a more education-specific model, it is imperative to understand how the four main constructs of the model relate to prior literature on teacher barriers to technology integration. Ertmer (1999) described two types of barriers at the teacher level that prevent the successful integration of technology into the classroom. On the one hand, first-order extrinsic barriers prevent teachers from integrating technology into their classrooms because they lack time, training, professional development, access to sufficient hardware and software, and support (Ertmer, 1999). These extrinsic limitations relate to the UTAUT construct of facilitating conditions (Venkatesh et al., 2003). On the other hand, second-order personal limitations, including teaching beliefs, perceived value of technology for education, and comfort with technology also affect whether or not teachers embrace technology in their classrooms (Ertmer, 1999). These personal limitations correspond to the remaining three UTAUT constructs, namely performance expectancy, effort expectancy, and social norms (Venkatesh et al., 2003). Others have supported Ertmer's (1999) distinction, showing that teachers feel both limited by the structural elements of their environment and their personal beliefs (Mueller, Wood, Willoughby, Ross, & Specht, 2008; Parette, Quesenberry, & Blum, 2010; Wachira & Keengwe, 2010), thus supporting the use of a modified version of the UTAUT to understand teacher practices with technology in the classroom.

1.3. Teacher barriers to technology integration

With the increase in schools' general access but the continued under-use of technology, some have noted that personal barriers may play a more important role in changing whether and how much teachers integrate technology into their classroom (e.g., Ertmer, Addison, Lane, Ross, & Woods, 1999; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Zhao, Pugh, Sheldon, & Byers, 2002). Ertmer (2005) distinguished between beliefs and knowledge by using Calderhead's (1996) definition: beliefs refer to "suppositions, commitments, and ideologies," while knowledge is "factual propositions and understandings." A teacher may have the knowledge of how to use a technology, which results from breaking down first-order barriers, but this does not necessarily lead a teacher to believe in the value of the technology for her teaching practices. Indeed, researchers have found that individual attitudes, such as confidence with or anxiety about using technology, have been correlated with actual use of technology, such that those more in favor of technology or more open and willing to try it are more likely to adopt technology in their classroom (e.g., Calderhead, 1996; Clark & Peterson, 1986; Pajares, 1992). As Cuban (1993) concluded, "It is a belief system, not an economic or empirical warrant, that determines failure or success" (p. 194) when integrating technology into the classroom.

Research is mixed on whether or not teacher beliefs and attitudes are significant predictors of use above and beyond first-order extrinsic barriers. Some empirical evidence exists supporting the predictive power of beliefs to shape behavior (Kagan, 1992; Pajares, 1992), but others have noted inconsistencies between teacher beliefs and actual practices, which tend to result from extrinsic constraints (e.g., Ertmer, 2005; Ifenthaler & Schweinbenz, 2013; Wood et al., 2008). While belief systems impacted their practice with technology, the teachers also felt constrained by extrinsic factors. Similarly, Ifenthaler and Schweinbenz (2013) found variations in attitudes across teachers implementing tablet PC devices, where attitudes toward technology in addition to performance expectancy and extrinsic conditions influenced their actual use of the devices. Inan and Lowther (2010) found that while personal efficacy and beliefs about the benefits of technology influenced actual use, extrinsic factors, such as school support and professional development, helped shape teacher readiness and attitudes toward technology, suggesting that use stems from the relationship between first-order extrinsic barriers and second-order personal barriers.

1.4. Technology in early childhood education

Research on teacher barriers to technology use has primarily focused on K-12 education, often making generalizations about how first-order and second-order barriers influence technology integration across teachers of all grades. While this research provides a background for investigating early childhood educators, it is important to note that early childhood educators are different than K-12 teachers in several ways. First, teachers of young children tend to be less educated than K-12 teachers. The most recent National Institute for Early Education Research (NIEER, 2013) report, *The State of Preschool 2012*, reported only 58% of state preschool programs required teachers to have a bachelor's degree and only 29% required assistant teachers to have a Child Development Associate (CDA) credential. Additionally, 85% of state-funded preschool teachers have specific training in early childhood education (NIEER, 2013). Second, early childhood programs are varied in quality (e.g., Hynes & Habasevich-Brooks, 2008), and despite new initiatives to provide a more universal quality measure (i.e., the Quality Rating and Improvement System), there remains no required quality assessment for programs. Third, teacher turnover rate is estimated at 20–50% annually in early childhood education (Barnett, 2003).

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