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Factors influencing digital technology use in early childhood education

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ABSTRACT

The current study uses path modeling to investigate the relationship between extrinsic and intrinsic factors that influence early childhood educators' digital technology use. Survey data from 1234 early childhood educators indicate that attitudes toward the value of technology to aid children's learning have the strongest effect on technology use, followed by confidence and support in using technology. Additionally, student SES has the strongest effect on attitudes, while support and technology policy influence teacher confidence, which in turn influences attitudes. In contrast, more experienced teachers have more negative attitudes. Overall, the study provides the first path model investigating early childhood educators' technology use and provides practical considerations to aid teachers' use of technology in the classroom.

1. Introduction

Historically, many educators and policymakers alike have valued the potential of digital technology to revolutionize the education system. From the introduction of educational television to the large-scale federal E-Rate program subsidizing Internet connectivity to the current investment in iPads from school districts around the nation, each new technology is introduced with the potential to benefit children's learning (Wartella & Robb, 2007). Indeed, in 2010, the U.S. Department of Education released the National Education Technology Plan to promote student-centered learning with technology as a way to improve student achievement (U.S. Department of Education, 2010), and most recently the Federal Communications Commission announced a $3 billion investment along with additional investments by private technology companies to "close the technology gaps in our schools" (qtd. in Bidwell, 2014). Further, school districts are spending millions of dollars on newer devices, including LA county, the second largest school district in the country, which spent $30 million on iPads for every k-12 classroom (Svensson, 2013).

Despite the excitement around technology, some school leaders and policymakers may fail to recognize that technology in and of itself may not have the inherent power to change teaching and learning practices. Teachers are a powerful mediator of technology's impact on student learning (Neiderhauser & Stoddart, 2001), but there is a lack of evidence that teachers are effectively integrating technology into their classrooms (Keengwe, Onchwari, & Wachira, 2008). Even with increased access to technology, the National Education Association and American Federation of Teachers (2008) asserted, "we have few assurances that [educators] are able to use technology for teaching and learning" (pg. 1), suggesting barriers exist above and beyond access that prevent teachers from successfully integrating technology into their classroom. Indeed, intrinsic barriers, such as preexisting teaching beliefs, attitudes toward the educational value of technology, and comfort with technology have been shown to influence the ways in which teachers use technology in the classroom (Ertmer, 1999; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010).

In light of this research and the federal and local initiatives to promote technology use in the classroom, the current study investigates both the factors that influence teacher use of technology as well as the relationship between these factors. Given the importance that early childhood education has on children's future academic success and life trajectory (e.g., Chetty et al., 2011; Isaacs, 2008), this study focuses

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specifically on early childhood teachers' attitudes toward technology for student learning for children birth through age 4. While we do not seek to make claims that more technology use equates to higher student achievement, we believe the focus on and investment in technology by the federal government and schools across the country warrants a closer look at what influences teachers' use of technology, given that technology must be used in the first place if it is to have any effect on student learning. Therefore, using survey data from 1234 educators, we explored various factors, both environmental and personal, that influence teachers' use of technology.

1.1. Technology integration

Despite increased access to computers and newer mobile devices, the actual use of technology in the classroom remains infrequent (Gray, Thomas, & Lewis, 2010), especially in early childhood education (Vockley & Lang, 2011; Wartella, Blackwell, Lauricella, & Robb, 2013). Further, when technology is used, it is often not used in meaningful, student-centered ways but is integrated in more traditional, didactic practices (Cuban, 2001; Ertmer & Ottenbreit-Leftwich, 2013). A survey of 35,525 K-12 teachers by Project Tomorrow (2011) showed that the most frequent use of technology is for homework and practice (58%), while Eteokleous (2008) described teachers' rare use of technology as "fancy chalkboards," suggesting technology is integrated in more didactic ways and as a substitute for more traditional tools, instead of as an extension of the curriculum. Others note that teachers primarily use technology for communicating with parents or preparing class materials instead of using it for student learning (Russell, Bebell, O'Dwyer, & O'Connor, 2003; Zhao, Pugh, Sheldon, & Byer, 2002).

Ertmer (1999) proposed one plausible explanation for this lack and ineffective use of technology, describing two types of barriers to technology integration. First-order extrinsic barriers prevent teachers from using technology due to a lack of access to technology, time to learn and use technology, training and support, and professional development. Second-order intrinsic barriers, on the other hand, limit teachers' use of technology due to teaching beliefs, comfort with technology, and perceived values of technology for student learning. Others have supported this distinction, showing that teachers feel both limited by the structural elements of their environment as well as their personal beliefs (Mueller, Wood, Willoughby, Ross, & Specht, 2008; Parette, Quesenberry, & Blum, 2010; Wachira & Keengwe, 2010).

Some have argued that second-order intrinsic barriers are actually more important to teachers' acceptance and use of technology than first-order barriers (Ertmer et al., 2012; Zhao et al., 2002). In recent years, access to technology as well as training and professional development opportunities have increased (Gray et al., 2010), but research continually shows teachers fail to integrate technology in their classrooms (e.g., Ertmer, Addison, Lane, Ross, & Woods, 1999; Ertmer et al., 2012; Zhao et al., 2002). Indeed, individual attitudes and confidence or anxiety about using technology are correlated with actual use, such that those more in favor of technology are more likely to adopt technology in their classroom (e.g., van Braak, Tondeur, & Valcke, 2004; Ertmer et al., 2012; Karaca, Can, & Yildirim, 2013; Lindahl & Folkesson, 2012). Additionally, teachers' pedagogical beliefs influence use, such that those with more student-centered beliefs are more likely to use technology in innovative and effective ways, compared to teachers with more traditional beliefs (Ertmer & Ottenbreit-Leftwich, 2013; Tondeur, Hermans, van Braak, & Valke, 2008).

1.2. Technology in early childhood education

Much of the research on teacher barriers has been conducted in K-12 learning environments, but the influence of personal beliefs on technology use may be even more pertinent for early childhood educators due to the debate over the place of technology in young children's lives. Research has shown that quality educational media can enhance young children's learning (e.g., Fisch & Truglio, 2001; Jennings, Hooker, & Linebarger, 2009). In their seminal study on *Sesame Street*, Anderson, Huston, Schmitt, Linebarger, and Wright (2001) demonstrated how watching quality educational television in the preschool years can lead to long-term academic and social benefits. Similarly, Penuel et al's (2012) randomized-controlled trial tested the effects of a media-rich literacy supplement that used television clips from popular PBS shows in preschool classrooms, and results showed children who received the media supplement made greater gains on letter recognition, phonics, and print and story concepts. Moreover, the National Association for the Education of Young Children (NAEYC, 2012) supports the developmentally appropriate and intentional use of technology in early childhood education.

In contrast, others have noted the potential negative impact of technology. Violent television and videogames, in particular, have been associated with aggressive and anti-social behavior (Anderson & Bushman, 2001; Anderson et al., 2003; Christakis & Zimmerman, 2007), while heavy television viewing has been associated with less time reading, decreased verbal literacy and theory of mind skills, and later attention problems (Christakis, Zimmerman, DiGiuseppe, & McCarty, 2004; Nathanson, Sharp, M., Aladé, Rasmussen, & Christy, 2013; Vandewater et al., 2005). In light of this, the American Academy of Pediatrics (2013) recommends no screen time for children under 2 and limited screen time for older children. Provided the differing views of the benefits and detriments of technology for young children, this environment likely influences early childhood educators' personal attitudes toward using technology for student learning in different ways than teachers of older children.

1.3. Technology integration model

Various models have been suggested to help explain the relationship between first- and second-order barriers with teachers' technology use (van Braak et al., 2004; Inan & Lowther, 2010b; Pynoo et al., 2013; Robinson, 2003). Most recently, Karaca et al. (2013) proposed a technology use model for Turkish elementary school teachers, and found that colleague support and technology competencies have significant positive associations while teaching experience has a significant negative association, and teaching attitudes/beliefs have a significant positive association on use. As one of the few studies to look at teachers of younger children, Karaca et al.' (2013) model provides a foundation to investigate use of technology in early childhood education. However, several modifications are necessary given the current study's focus on U.S. teachers of very young children.

First, research on teachers of older children suggests that a strong school technology vision can have positive associations with teacher attitudes toward and use of technology (Fullan, 2007; Lui, 2012; Somekh, 2008), a fact that may be heightened in early childhood education given the continued debate over the appropriateness of young children using technology. While Karaca et al. (2013) suggest using principal