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Young children's computer skills development from kindergarten to third grade

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ABSTRACT

This investigation explores young children's computer skills development from kindergarten to third grade using the Early Childhood Longitudinal Study–Kindergarten (ECLS–K) dataset. The sample size of the study was 8642 children. Latent growth curve modeling analysis was used as an analytical tool to examine the development of children's computer skills using LISREL software version 8.80. Results indicated, not surprisingly, that the availability of a computer at home and a high socio-economic status were statistically significant predictors of children's baseline computer skills in kindergarten. The availability of computers in kindergarten, however, was a statistically significant predictor of the development of children's computer skills from kindergarten to third grade. Although there was no difference between girls and boys in their baseline computer skills in kindergarten, the rate of development in computer skills was higher for girls than boys. Results suggest that the availability of an adequate level of computers in kindergarten classrooms can help close the initial gap in children's computer skills due to socio-economic status and lack of computer access prior to entering school. Supplying kindergarten classrooms with adequate computers could positively contribute to children's long-term development of computer skills.

1. Introduction

Computers have increasingly become a regular component of American classrooms, with the ratio of computers to children in the US increasing to one computer to every four children over the last two decades (Russell, Bebell, O'Dwyer, & O'Connor, 2003). Although some researchers question the effectiveness of computer-based instruction (Carlsen & Andre, 1992; Clark, 1994; Yaman, Nerdel, & Bayrhuber, 2008), a growing body of literature provides increasing evidence of the effectiveness of using computer technology to facilitate instruction and learning across a variety of school subjects (Bayraktar, 2002; Clements, 2002; Kulik & Kulik, 1991; McKenney & Voogt, 2009; Mioduser, Tur-Kaspa, & Leitner, 2000; Trundle & Bell, 2010). National academic content standards identify the use of technology among the skills that students should develop throughout their education (International Society for Technology in Education [ISTE], 2003). In recent studies, computer skills were reported to be one of the top skills parents expect their children to develop (Healy, 2000), and employers expect college graduates to have computer skills (Davis, 1997).

National standards encourage the use of computer technology in classrooms. For example, the *National Science Education Standards* (National Research Council [NRC], 1996) suggest that "all students in grades K-4 should develop the ability to use and understand science through technology and technological tools that help students make better observations and measurements" (p. 138). This increasing emphasis on the use of computer technology in schools highlights the importance of computer skills in children's academic success.

Previous research has demonstrated that children do not have equal opportunities to access computer technology at home and in schools (Attewell, 2001; Norris, Sullivan, Poirot, & Soloway, 2003). Researchers have reported that children with high socio-economic status and children who attend low-poverty schools are more likely to have access to computer technology (Calvert, Rideout, Woolard, Barr, & Strouse, 2005; Judge, Puckett, & Cabuk, 2004). This difference in access to computers changes as children move to the upper grades because the availability of computer technology between low-poverty and high-poverty schools becomes narrower or completely diminishes in the

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upper grades of school (Judge, Puckett, & Bell, 2006). Nevertheless, children with high socio-economic status continue to have better access to computer technology at home than children with a low socio-economic status. This differential access to a computer at home might provide an advantage to children with a high socio-economic status over children with a low socio-economic status in terms of developing their computer skills (Mumtaz, 2001). Some scholars have described this difference in availability of technology and the resulting gap in information access as a "digital divide" (Attewell, 2001). More and more children have access to computers at home and this access to technology seems to contribute to the development of children's cognitive and non-cognitive skills (Fiorini, 2010; Poynton, 2005). Previous studies have mainly focused on investigating children's computer access and its potential influence on academic performance (Poynton, 2005). However, the influence of the digital divide on the development of young children's computer skills has not been widely examined in the literature. Limited literature exists on the development of children's computer skills. These studies suggest that motor development, executive functioning abilities, and cognitive maturation influence children's use of computer technology and even five-year old children can effectively use computer input devices (Clements, 2002; Donker & Reitsma, 2007; Lane & Ziviani, 2010; Lauricella, Barr, & Calvert, 2009). Previous studies also demonstrated that although parental scaffolding is important, children are able to develop computer skills with minimal or no adult guidance, and access to computer technology can promote children's computer literacy (Inamdar, 2004; Lauricella et al., 2009; Mitra & Rana, 2001).

Success of computer-assisted instructional strategies is largely seen as dependent on teachers' acceptance of the use of technology in their classrooms and teachers' own skills and experiences in using technology (Hu, Clark, & Ma, 2003). Although children's computer skills also seem to be a vital part of the success of computer-assisted instruction, the importance of children's computer skills have been largely overlooked in the literature partly because such data have not been available. However, the Early Childhood Longitudinal Study–Kindergarten (ECLS–K) data set provides nationally representative data to address these types of questions. Therefore, this study used the ECLS–K data to explore the development of children's computer skills from kindergarten to third grade by considering their access to computer technology in kindergarten.

2. Conceptual model tested in the study

The latent growth curve modeling approach was used to model the development of children's computer skills from kindergarten to third grade. Four variables were used as predictors of children's computer skills in the model. While gender, socio-economic status, and the availability of a computer at home were used as predictors of both children's initial computer skills and the development of children's computer skills, the availability of computers in kindergarten classrooms was only used as a predictor of the development of children's computer skills. The availability of a computer at home and children's socio-economic status were allowed to covary as children with high socio-economic status were expected to be more likely to have access to a computer at home.

Although earlier studies indicated a possible gender difference that favors older boys over older girls in computer usage (Essa, 1987; Hess & Miura, 1985), more recent studies suggest that there might be no longer a gender difference among 3–17 year old children in computer usage (Newburger, 2001). Nevertheless, the use of computers seems to appeal to boys more than girls, which might lead boys to have better computer skills than girls. Therefore, gender was used as a potential predictor of children's initial computer skills as well as the development of children's computer skills in the model. Socio-economic status appears to be another potential predictor of children's computer skills. Children with a high SES are more likely to have access to a computer at home and parents with higher computer literacy. Thus they are more likely to have opportunities to develop their computer skills (Becker, 2000; Calvert et al., 2005). Moreover, the research literature suggests a positive link between children's home experiences and their mathematics, reading, and science learning skills at schools. Results of these studies demonstrated that children who had access to materials, such as print media, educational toys, and other learning materials, at home were more likely to perform better on academic tasks than their peers who did not have access to such materials at home (e.g., LeFevre, Polyzoi, Skwarchuk, Fast, & Sowinski, 2010; Yaghoub Zadeh, Farnia, & Ungerleider, 2010). Therefore, SES and the availability of a computer at home were used as potential predictors of children's initial computer skills and the development of children's computer skills. The availability of computers at school is a potential predictor of the development of children's computer skills (Becker, 2000). Children who don't have access to a computer at home might find opportunities to develop their computer skills in classrooms where computers are available. Thus, the availability of computer technology in kindergarten classrooms was used as a predictor of the development of children's computer skills in the model. The main purpose of this study was to examine the impact of the availability of computers in kindergarten classrooms on the development of children's computer skills, rather than to examine the change in children's access to computers in the early years. Because, the change in children's access to computers in schools was investigated in previous studies (Judge et al., 2004, 2006) the availability of computers in the first and third grade classrooms was not included in the model tested in the current study.

3. Purpose of the study

The purpose of this study was to investigate the development of children's computer skills from kindergarten to third grade and the predictors of children's computer skills. More specifically, answers to the following research questions were sought in the study: (1) Do the socio-economic status, gender, and availability of a computer at home predict children's initial computer skills at kindergarten and the development of children's computer skills from kindergarten to third grade? (2) Does the availability of computers in kindergarten classrooms predict the development of children's computer skills from kindergarten to third grade?

4. Methodology

4.1. Sample

The ECLS–K cohort data were collected using a multistage probability sample design that included stratification, clustering, and oversampling of certain subpopulations (National Center for Educational Statistics [NCES], 2002). The base year sample (1998–1999) consisted of 22,666 children from 953 public and 460 private schools, and children were followed from kindergarten until the eighth grade. ECLS–K