Computers & Education 70 (2014) 184–193

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Does technology empower urban youth? The relationship of technology use to self-efficacy

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ARTICLE INFO

Article history:
Received 9 April 2013
Received in revised form
17 July 2013
Accepted 20 August 2013

Keywords:
Digital inequalities
Digital divide
STEM subjects
Elementary school students
Internet activities

ABSTRACT

Many propose technology as a tool for empowerment of lower SES urban students, but little research has investigated the relationship between technology and empowerment for this population. We investigate how different aspects of technology use and ownership could empower urban youth through increasing their self-efficacy. Instead of simply a general measure of self-efficacy, we focus on several important domains related to STEM (Science, Technology, Engineering, and Mathematics) subjects including technological, mathematics/science, academic, and general self-efficacy. Our investigation incorporates many aspects of technology use by considering first level digital divide characteristics, such as ownership and total amount of use, and second level digital divide characteristics, such as specific communication, multimedia, content creation, and social networking activities. We use a unique survey of fourth and fifth grade students who were given a laptop, thereby controlling for the typical disparity in computer ownership and access among lower SES students. We found that technology use influences each domain of efficacy in specific ways, indicating the importance of considering multiple domains of self-efficacy. Most notably, frequency of communication and especially frequency of email use related to all four domains of efficacy and frequency of playing games related to general, mathematics/science, and academic efficacy. However, social networking activities had a negative association with academic and general efficacy. We conclude by considering the importance of multiple domains in self-efficacy research and policy implications for students and their schools.

1. Introduction

Many have proposed that youth's access and use of affordable computer technology would level inequalities, enhance learning opportunities, and lead to academic and career success. The research generally supports that: youth's engagement with information and communication technologies increases their integration in the community, development of skills, and social capital (London, Paster, Servon, Rosner, & Wallace, 2010; Valaitis, 2005), politiosocial participation (Thackeray & Hunter, 2010), and reduces disparities between genders (Khan & Ghadially, 2010). Not surprisingly, among lower SES youth, technology interventions promote academic interest in STEM (science, technology, engineering, and mathematics) subjects (Martin et al., 2011; Nugent, Barker, Grandgenett, & Adamchuk, 2010) and careers (Wilson, Iyengar, Pang, Warner, & Luces, 2012). One important outcome of young peoples' engagement with technology is whether they are empowered to succeed within and beyond the domain of technology (Amichai-Hamburger, McKenna, & Tal, 2008). Students' self-efficacy – the belief in one's own abilities, control, and agency – is a key component in students' academic success and STEM-related careers. In this paper we explore the relationship of technology use to different domains of self-efficacy for a population of particular interest and surprisingly understudied: disadvantaged urban youth.

We ask if and how engagement with technology can empower youth by considering self-efficacy in general and in relation to STEM subjects. Following the trajectory of digital divide literature (Attewell, 2001; van Dijk, 2006), we model the relationship between efficacy and first level digital divide factors (i.e., ownership and access frequency), then add to this model second level digital divide factors (i.e., specific uses of technology). In our sample of a high-poverty urban school system, students were given specialty laptops called XO laptops. Because this scale of XO laptop dissemination was unprecedented in the United States (Warschauer, Cotten, & Ames, 2012), our sample

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http://dx.doi.org/10.1016/j.compedu.2013.08.018

provides a unique opportunity to examine a large number of students with access to resources useful for empowerment. Aside from our unique sample, we add to the literature in three major ways. First, we study elementary school children, a group understudied in self-efficacy research. Second, while most research considers only one domain of self-efficacy, we simultaneously consider four domains of self-efficacy in order to understand how technology use empowers students in general and in relation to STEM education. Third, we do not use a simple measure of time spent on computers, but engage in a detailed examination of computer and Internet activities.

2. Background

2.1. Self-efficacy

Social psychologists view the perception of the self as one's self-concept (Rosenberg, 1979, 1981), which includes multiple elements developed through self-reflection and cultural perceptions (Mead, 1934). The meanings associated with the self primarily include self-esteem and self-efficacy. Self-esteem – the evaluative component of the self – has often been studied in its relationship to technology (e.g., Rohall, Cotten, & Morgan, 2002; Wang, Jackson, Zhang, & Su, 2012; Witt, Massman, & Jackson, 2011). Self-efficacy – the power and control component of the self – has been less studied in its relationship to technology, especially among disadvantaged youth, yet self-efficacy remains important for the long-term development and success of youth (Hackett, 1997; Halleröd, 2011). Whereas particular technological skills may become outdated and communities change, an internal sense of empowerment and ability can carry an individual throughout her life (e.g., Halleröd, 2011).

The terms empowerment and efficacy have historically been used in many different ways. Some use the terms interchangeably (e.g., Enderlin-Lampe, 2002), while others propose that empowerment either requires two people – one empowering and the other becoming empowered (e.g., Robbins, Crino, & Fredendall, 2002). Some conceptualize empowerment as including other components besides efficacy, such as autonomy and motivation (e.g., Edwards, Green, & Lyons, 2002; Vincenz, 1990), whereas others refer to it as a philosophy of business management (e.g., Lee & Koh, 2001). In spite of the range of uses (see Gecas, 1989; Lee & Koh, 2001 for reviews), we have elected to follow Bandura's self-efficacy research tradition (1997). He describes self-efficacy as a psychological perception that is predictive of behaviors. This efficacious perception empowers people as it is coupled with agentic action and meaningful outcomes (Bandura, 1997). Here we seek to understand how engagement with technology relates to empowerment by focusing on how patterns of interaction with technologies alter self-efficacy.

One form of self-efficacy is the general belief about one's own empowerment, agency, and abilities, while other forms apply to specific domains. Bandura (1997, 2006) proposes that if different domain-based self-efficacies rely on common skills or are developed in a common social context they are more likely to be related. In schools, for example, "students are likely to develop similarly high perceived self-efficacy in dissimilar academic subjects, such as language and mathematics" (Bandura, 2006: p. 308). Others view domain-specific self-efficacy as simply general self-efficacy applied within a domain. For example, "computer self-efficacy is based on an already formed sense of self-efficacy and represents its fundamental elements applied in the fields of use and mastery of computers" (Paraskeva, Bouta, & Papagianni, 2008: p. 1085).

Bandura argues that a general measure of self-efficacy is limited in its predictive power as it cannot be relevant to all of the behavioral domains (2006). Therefore, domain-specific efficacy predicts better than its global counterpart but is a less parsimonious explanation of human behavior. Surprisingly, scholarship shows little discussion of the boundaries among domains, especially in the areas of STEM education. In relation to academia, Bandura argues that academic efficacy encompasses too broad a domain with fundamentally different scholastic skills (1997: pp. 47–50). In contrast to Bandura's domains, some researchers conceptualize general self-efficacy as a dimension of a larger construct itself, e.g., efficacy and worth have been considered two components of self-esteem (Cast & Burke, 2002; Gecas & Schwalbe, 1986).

This tension between domains of self-efficacy is especially problematic when considering STEM academic fields and technology more generally. Most research in this area considers only one type of self-efficacy: general technological self-efficacy (Huffman, Whetten, & Huffman, 2013), computer self-efficacy (Kher, Downey, & Monk, 2013; Vekiri & Chronaki, 2008), Internet self-efficacy (Chang et al., 2013; Kim & Glassman, 2013), science self-efficacy (Chen & Usher, 2012; Kıran & Sungur, 2012), mathematics self-efficacy (Phan, 2012), mathematics/science self-efficacy (McMahon & Wernsman, 2009), or academic self-efficacy (Putwain, Sander, & Larkin, 2012). However, a few researchers have considered multiple types, such as general and computer self-efficacy (Paraskeva et al., 2008), academic and Internet self-efficacy (Joo, Bong, & Choi, 2000), or even general, Internet, and computer self-efficacy (Broos & Roe, 2006). None of this research considers the relationship of multiple domains of self-efficacy with participation in a range of Internet activities.

In this paper we seek to add to this literature by examining the complex relationship among computer use, Internet activities, and the multiple domains of self-efficacy associated with academic STEM subjects. It is well-documented that both perceptions of ability and actual outcomes within a domain relate to domain-specific efficacy (Bandura, 1997). For example, academic achievement relates to academic self-efficacy (Caprara, Vecchione, Alessandri, Gerbino, & Barbaranelli, 2011) whereas computer use, accomplishments, and confidence relate to computer self-efficacy (Hsiao, Tu, & Chung, 2012; Vekiri & Chronaki, 2008). Furthermore, academic and technology-based efficacies often are only related to outcomes within their own domains (Joo et al., 2000). While particular studies consider efficacy as either a cause or an outcome, the causal direction of the relationship is often reciprocal (Gecas, 1989).

We propose a more complex understanding of the forms of self-efficacy in relation to students' interaction with technology. The specific uses of technology could empower students in the realm of technology, or, alternatively, technology could simply function as a medium through which one becomes more or less efficacious. To tease out the different possibilities, we examine four domains of self-efficacy. General self-efficacy, perhaps the most studied, provides an overarching measure. In relation to computers and Internet use we have selected technological self-efficacy. As opposed to computer or Internet self-efficacy, both used in other research, we opted for technological self-efficacy because it captures the breadth of empowerment through and with a range of computer platforms, applications, and websites. Considering the assumption in STEM programs that mathematics and science are directly related to technology, we include the domain of mathematics/science[1] self-efficacy. Finally, as a comparison with the mathematics/science self-efficacy, we consider academic self-efficacy

[1] Although engineering is one of the four STEM fields, it is not a course in elementary schools. Therefore, we elect to use the combination of science and mathematics to represent the non-technology domain of the STEM fields.