US-China Education Review A 2 (2011) 153-161
Earlier title: US-China Education Review, ISSN 1548-6613

The Digital Divide and Its Impact on Academic Performance

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The purpose of this article is to explore issues of the digital divide and its impact on academic performance. Research shows that proper use of technology by students increases their academic performance outcomes. In the literature review section, the authors review articles and theories based on Bennett's (2001) societal equity framework. The findings show that students' academic performance is a function of many complex and interrelating factors. Although technology use is linked to socio-economic status and academic performance, educators should try to identify whether the cause of low or high academic achievement directly results from technology use, and how technology usage interacts with and affects other factors. In addition, socio-economic status may affect one's future career opportunities. Implications for future research and practice are also discussed in this article.

Keywords: digital divide, learning outcome, academic performance, education, information technology

Introduction

This article addresses issues of the digital divide in technology use and its impact on academic performance. Some researchers (e.g., Wenglinsky, 1998) have linked successful use of technology by students with academic performance outcomes, although this relationship has also been challenged (e.g., Baker, 2005). Moreover, since socio-economic disparity affects students' access to technology at home and in the classroom and their technology competence, this article aims to explore the relationships between the two factors, socio-economic status as well as technology usage, and the students' school performances.

Societal equity, the fourth cluster identified by Bennett's (2001) genres of research in multicultural education, focuses on equitable access in social organizations. Given that students' abilities to access to technology and their academic performance are determined largely by their families' socio-economic status (Stanton-Salazar, 1997), the societal equity framework is used as the major guidance of this paper. The authors use the findings regarding educational opportunities and the effects of poverty on children from Blossfeld and Shavit's (1993) and Brooks-Gunn and Duncan's (1997) articles to support their conclusion.

Research Questions

This article discusses the relationships between technology use, students' academic performances and students' socio-economic (see Figure 1). Because the ability to use technology at least partly depends on students' socio-economic status, the authors address the issue of socio-economic disparity, its relationship with

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technology use, and the impact of these two factors on academic performance. Given the empirical and theoretical importance of these issues, the core research question of this article is first and foremost, what are the relationships, if any, among technology use, students' academic performance and students' socio-economic status? In other words, how does socio-economic status affect the availability of technology of students? Second, how does technology use affect students' academic performance? Third, does the lack of technology use impair students' academic performance? Additional questions include: Would students' academic performance recursively impact the technology usage and socio-economic status? Are there other factors that may mediate or moderate the associations between the social and technology disparity and academic outcomes? This article focuses on the first three questions, although all of these questions are relevant to comparing social equality to educational outcomes.

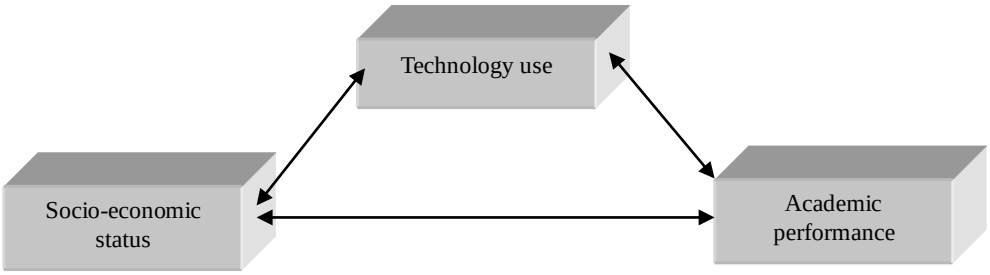

Figure 1. Model of research questions.

Definition of Key Terms in the Paper

Following Mason and Dodds (2005a; 2005b), the digital divide is defined as the gap between the students who have access to digital technology at home and those who do not. The factors causing the gap include socio-economic status, ethnicity and geographic location, while socio-economic status is the focus of this study.

"Information technology" refers to the use of computers to access and share information. It includes the implementation, management, design and research of the system including computer hardware and software (Information Technology Association of America, 2007).

As a widely used phrase in a variety of disciplines of social sciences, in this article, "social capital" is specifically defined as the "relationships with institutional agents, and the networks that weave these relationships into units" (Stanton-Salazar, 1997, p. 8). In other words, social capital is the advantages of a person resulted from his/her relationship with other people or institutions.

Theoretical Framework

Societal equity, the theoretical framework of this study, is the fourth cluster of Bennett's (2001) genres of research in multicultural education. The societal equity framework is divided into three genres: "(1) demographics; (2) culture and race in popular culture; and (3) social action" (Bennett, 2001, pp. 200-204). The demographics genre focuses on the population that is mixed with diverse groups, including people from different socio-economic status and ethnic backgrounds. It also includes immigration, since immigrant families play important roles in the population. The second genre, culture and race, encompasses course content, including the media and material used in the classroom, and whether the textbooks and media contain bias and prejudice. The third genre, social action, refers to the action taken by either individuals or a group to improve or reform a school system. Research in this genre encourages individuals or groups to become change agents

devoted to eliminating inequities.

Societal equity focuses on "equitable access" to utilize social resources (Bennett, 2001). The research using this framework involves an action plan to improve the existing school systems and create equality in the learning environment. As equitable access to social organizations requires appropriate allocation and distribution of resources, economic policies also play an important role in this framework. This framework serves as the foundation of this article's investigation of the digital divide and its impact on academic performance.

Literature Review

Research on societal equity framework focused on "aspects of equitable access, participation and achievement in social institutions" (Bennett, 2001, p. 200). Besides briefly reviewing articles and theories based on the societal equity framework, this section introduces a brief history of technology use in educational spheres and attempts to build the linkage between these two issues based on the literature. This section is structured as follows: (1) technology use in the school system; (2) socio-economic status and technology use; (3) socio-economic status and academic performance; and (4) technology use and academic performance.

Technology Use in the School System

The use of technology to assist in teaching and learning has an extensive history in the American education, long before the invention of personal computers in the late 1970s (Fletcher, 2003). For example, the PLATO (Programmed Logic for Automated Teaching Operations) project (Fletcher, 2003, p. 79) was designed at the University of Illinois in the early sixties to help professors design and deliver self-paced course materials. IBM (International Business Machines) Research Center also developed programs to use computer technology to teach scientific and linguistic courses (Fletcher, 2003). Researchers of Stanford University invented ways to help elementary schools enhance their mathematics curriculum through the use of computer logic programs (Fletcher, 2003). In summary, research, invention and the use of new technologies within American school systems have been a part of the education system for close to five decades.

In spite of its long history, and research indicating that technology, if used appropriately, can increase teaching and learning efficiency and improve the quality of the curriculum (Morrison & Lowther, 2009; O'Neil & Perez, 2003), it has not become a prevalent tool in contemporary education. According to Galuszka (2007), technologies, such as the Internet and computers, were not in widespread use for academic purposes. Furthermore, compared to the major cities, technologies were less often utilized in rural schools. Although most of the schools in urban cities did have access to the Internet, students tended to use it for non-academic purposes, such as surfing the Internet and social networking. It is rarely, integrated into the curriculum. Furthermore, the accuracy of using technology to assess students' performances was still controversial (Baker, 2005).

The primary purpose of current educational technology is interactive instruction (Fletcher, 2003), which refers to the capability to teach a class bi-directionally. Interactive instruction requires group participation around technologies to deliver the course materials, play multimedia, use smart tutoring systems and communicate with each other. The challenge in the design of educational technology is to enable both teachers and students to participate in a class, even if they are not in the same location at the same time. With the aid of contemporary educational technology, students can take classes no matter where they are physically located, at their own convenience, with easy and uninterrupted access to online course contents and resources. Fletcher

(2003) asserted that if we take full advantage of all the available instructional technologies, everyone could become lifelong learners and gain new knowledge in a more efficient manner. Learners who can make effective use of technologies will be able to compete successfully in a rapidly changing, technology-driven world economy (Fletcher, 2003, p. 81).

Baker and O'Neil (2003) used the term "technological fluency" as a measure of how well people applied the technology and how well people used technology to improve their daily lives. Technology fluency is the knowledge and skills of making proper use of computer hardware, software and networks to enhance the quality of our lives. They also predicted that in the future, the use of technology would become a determining factor for every student to be successful.

In summary, the use of technology in education settings began in the mid-1950s, and the focus of educational technology has shifted to interactive instruction today (Fletcher, 2003), aiming at creating a bi-directional teaching and learning environment. Both Baker and O'Neil (2003) and Fletcher (2003) predicted that educational technology would be the major pathway to the future of the American education system. Galuszka (2007) further pointed out that proper use of technologies should increase teaching and learning efficiency and improve the quality of the curriculum.

Socio-economic Status and Technology Use

In this section, the authors review and compare different perspectives from the literature that discusses the relationship between socio-economic status and technology use in the American school system. The term "digital divide" is introduced as the gap between those students who have access to digital technology at home and those who do not (Mason & Dodds, 2005a; 2005b). Social capital framework is also discussed as a mediating factor, as children from minority groups or lower socio-economic milieu may have inferior social capital and less access to the educational resources, including the use of technology (Stanton-Salazar, 1997).

One of the digital divide issues pointed out by Galuszka (2007) is the inequitable distribution of technology resources. Although technologies, such as telecommunication and broadband, are widely deployed in US, companies selectively choose where to deploy these technologies, sometimes circumventing disadvantaged neighborhoods along with their school districts. Therefore, policy makers have to ensure the equal distribution of the technology resources, so that urban, suburban and rural schools have equal opportunities to implement educational technologies in their classrooms and across their curricula.

Furthermore, the most serious issue regarding digital divide was that underrepresented groups did not have sufficient access to the technology resources (Milheim, 2006). Although progress has been made to close the gap, new problems have arisen. For example, low-income parents might not be able to afford technology equipment and network access fees, despite the fact that they might value the use of technology. Milheim (2006) suggested that policies should be improved so that schools and low-income families can get sufficient support at home from private donors and the government.

In the article "Measuring the state of equity in public higher education", Bensimon, HAO, and Bustillos (2006) used the academic equity scorecard framework to analyze African Americans and Hispanics' opportunities to attend public higher education institutions. The academic equity scorecard measures equity in educational outcomes from four perspectives: (1) students' accessibility to colleges; (2) students' retention rate; (3) students' excellence; and (4) institutional receptivity. Based on their study, Bensimon et al. (2006) concluded that there is a gap between minorities and white students in accessing resources. Bensimon et al.

(2006) predicted that, by 2015, African Americans and Latinos would be underrepresented in managerial, technical and educational jobs due to their lack of technical skills and higher education degrees. The implication of minorities' access to technology and college degrees will be discussed in Section of "Implications for future research and practice".

Holme (2002) examined how affluent white parents chose neighborhoods where their children could attend preferable schools. Based on her findings, Holme asserted that parents used information from their social network to decide which school district was more desirable. When parents in high socio-economic status chose schools, they tended to choose those with students from other wealthy or prestigious families. The outcome is that upper-income parents had access to high quality schools while lower-income parents had limited selection of schools nearby their neighborhoods. The "very diverse and low-income feeder middle schools" (Holme, 2002, p. 196) provide limited resources to students and result in low quality learning environment. She suggested that schools should give less-affluent parents equal access to the same schools that affluent white parents opt for their children. Outside the scope of this paper is the related topic of America's desegregation busing laws of the 1970s and 1980s. Under federal court supervision, many school districts implemented mandatory busing plans within their districts to integrate schools and equalize access to quality education.

Socio-economic status not only affects students' accesses to institutional resources, but also constrains their opportunities to use technology, since lack of institutional resources is one of the causes of unequal access to technologies (Dika & Singh, 2002). To eliminate the inequality issues and maintain societal equity, Bennett (2001, p. 200) proposed that educators should ensure freedom and equality in the society.

Socio-economic Status and Academic Performance

Although the focus of the literature review in this study is to depict the relationship between socio-economic status and technology use and the relationship between technology and students' academic performances, socio-economic status might directly affect students' academic performances as well. By reviewing articles describing socio-economic status and social capital, the effect related to technology use can be clearly identified.

Social capital creates barriers and inequality between minority children and educational institutions (Stanton-Salazar, 1997). For example, in contrast to the working-class minority group, the middle-class group has the privilege to take "social freeways" (p. 4) that allow people to move up the socio-economic ladder more quickly and efficiently. Socio-economic status has significant influence on one's social capital. In the article "Application of social capital in educational literature: A critical synthesis", Dika and Singh (2002) discussed the relationship between social capital and educational outcomes. Based on their review, Dika and Singh found that social capital is positively linked to: "(1) educational achievement; (2) educational attainment; and (3) psychosocial factors that affect educational development" (p. 36). However, they pointed out that there is insufficient theoretical and empirical evidence to validate the aforementioned relationship.

Bennett's (2001) societal equity framework is based on the idea that equitable economic policies are necessary in order to integrate diverse minority groups, including those from low socio-economic status. According to Schulz's (2005) findings, most students from high socio-economic families lived in better neighborhoods, and therefore, the quality of their schools was better. While the quality of schools may not be the major indicator to measure students' educational outcomes, the schools do have an effect on students' learning processes and effects. The results show that socio-economic status does not affect students' academic

performances in early stage, but it does affect students' educational outcomes in the long-term. The relationship between socio-economic status and academic performance, however, is not deterministic. For example, Fransoo, Ward, Wilson, Brownell, and Roos (2005) reported that many students with high socio-economic status may lack satisfactory academic achievement.

Technology Use and Academic Performance

Based on Bennett's (2001) societal equity framework, educators should adopt various knowledge to create a diverse classroom environment and equal access to resources. It follows then that it should be important for different groups to have equal opportunity to access to and use technology. As pointed out in the research by the DITI (Diversity in Information Technology Institute), offering technology in classroom training for diverse students can motivate young people, especially minorities, to learn new knowledge (Kelly, Dawson, & Teresa, 2007).

Fletcher (2003) indicated that many institutions debated whether they should use technology-enhanced learning instruction, because they cannot find a direct correlation between technology use and students' academic performances (Russell, 2001). However, according to Fletcher (2003), using technology can significantly reduce the time for training. He first found out that it takes more time to train kindergarten students in the setting of one-on-many classroom instruction than in one-on-one tutoring. He then found that technology can simulate one-on-one training to better students' understandings in difficult subjects. Technology also can enhance the advantages of the one-on-one training, which allows teachers to adapt to diverse students' needs. As Bennett (2001) pointed out in her societal equity framework, the educator "expands and explores multiple areas of knowledge, perspectives and understandings of research and practice in multicultural education" (p. 206). Using technology to simulate the one-on-one training not only potentially eliminates the conflicts that students may have in the classroom, but also enhances the efficiency of delivering knowledge (Fletcher, 2003).

Similar to Fletcher's (2003) findings which focus on the time reduction in technology use, Galuszka (2007) found that technology can increase students' performances in learning mathematics. In his research at MIT (Massachusetts Institute of Technology), Galuszka (2007) integrated the subjects of math and science into a Web technology program, and he found that students improved their math scores. The reason why technology improves students' performances in math and sciences is that almost all of the various technologies, such as the Internet, personal computers, cell phones, iPods, etc., come from the "underlying disciplines of math and science and engineering and technology… they are a natural fit" (Galuszka, 2007, p. 22).

In contrast to those who considered technology as a panacea to improve students' performances, Baker (2005) asserted that technology is not a "magical tool" to correct the problems in educational settings. To increase students' academic performances, accountability and long-term education plans and career options, it is important to consider their actual needs and how technology can address these requirements when introduced into the classroom. It is also important to avoid "fool's gold" (Baker, 2005, p. 734), which refers to an apparent improvement in performance immediately after applying the technology that declines soon after.

Fletcher (2003) proposed that technology has the one-on-one tutoring effect, and therefore, increasing learning efficiency. It also complements that Bennett's (2001) societal equity framework in that technology should be able to simulate one-on-one training needed to eliminate social conflict in the classroom. Galuszka (2007) also empirically found that technology can increase students' academic performances, especially in learning mathematics and science subjects. In contrast to Fletcher (2003) and Galuszka (2007), Baker (2005)

did not think that technology should be treated as the panacea for educational issues. He asserted that, with a thorough plan and an effective assessment system, students' academic performances enhanced by technology support can be accurately measured and may produce positive outcomes.

Findings

The purpose of this article is to explore the relationships among technology use, students' academic performance and students' socio-economic status. In the literature review section, the authors review articles and theories based on the societal equity framework including the aspect of technology to reflect on the purpose of this study. Based on the review, this paper proposes that first, the use of technology is a trend in American education systems (Baker & O'Neil, 2003; Fletcher, 2003). However, in order to use technology as an accelerator to improve teaching and learning efficiency, it must be leveraged appropriately rather than blindly introduced into classrooms (Galuszka, 2007).

Second, socio-economic status and social capital not only affect students' accessed to institutional resources, but also affect their opportunities to use technology (Dika & Singh, 2002). Based on Dika and Singh's (2002) findings, superior social capital results in better educational outcomes.

Third, it is inconclusive whether technology is going to affect students' academic performances in all subjects, but research found that at least mathematics and science are positively linked to technology use (Fletcher, 2003; Galuszka, 2007). Furthermore, although technology is not a panacea that can unconditionally enhance students' learning, with targeted plans and an effective assessment systems, students' academic performances can be accurately measured and may produce positive outcomes (Baker, 2005).

Discussion

In summary, students' academic performance is a function of many complex and interrelating factors. Although technology use is linked to socio-economic status and academic performance, educators should try to identify whether the cause of low or high academic achievement directly results from technology use, and how technology usage interacts with and affects other factors. Besides, when educators leverage technology in an academic setting, they should select subjects that have proven to benefit from the use of technology.

In the long term, socio-economic status may affect one's future career opportunities. Those who receive low quality education and do not have satisfactory academic performance may suffer from disadvantages in the labor market and have fewer options to move up on the socio-economic ladder. If the number of economically disadvantaged people increases, the national economy as a whole may also be negatively impacted.

Implications for Future Research and Practice

The scope of the current study is mostly confined to short-term effects of technology use. However, long-term effects, such as the impact on one's career choices, are also important. One example is the long-term effect resulting from the widening gap of knowledge associated with socio-economic status. Many low-income families do not have a computer at home or access to the Internet, and schools in poor neighborhoods tend to have less technology equipment and offer less training in computer applications. Children in low-income neighborhoods are less adept in using computers, which has lifelong consequences, as they not only lack the basic computer skills, but also have fewer accesses to the digitally disseminated information and knowledge. This inequality may have a sizable impact on their future employment opportunities, as they are ill prepared

and thus disqualified for better paying jobs that require basic computer skills.

Digital literacy and computer skills are now a requirement for all college students. Minorities or underserved students from low-income families may not be competitive candidates or be accepted into college with insufficient technology skills. Even students who are accepted into college may struggle to complete their studies due to a lack of technological skills. Ultimately, the lack of a college degree will result in more inequality issues across US. Taking African Americans and Latinos in the US for an example, Bensimon et al. (2006) predicted that, by 2015, African Americans and Latinos would be underrepresented in managerial, technical and educational jobs due to their lack of higher education degrees. Therefore, it is important to ensure that students with low socio-economic status have equal access to technology in their early educational experiences.

New instructional methods could help to mediate some of these obstacles for students behind the learning curve. It includes just-in-time learning, open-source and free software applications, cohort mentoring (both online and face-to-face), and access to multimedia rich learning modules available through free YouTube, Apple iTunesU, and other educational Websites (Bell, 2009; Berger & Trexler, 2010; Morrison & Lowther, 2009).

Psychological aspects are also an important factor affecting the relationships among socio-economic status, technology use and students' academic performances. One of the theories in social cognitive psychology is the "modeling effect", which describes how people imitate behavior demonstrated by others surrounding them (Ormrod, 2006). In addition to socio-economic disparities, students' and their parents' perceptions of the importance of technology use may also result in digital divide. If parents do not think technology is an essential tool in their children's education, they may not choose to invest in technology which may eventually negatively affect their children's learning abilities.

Lastly, as socio-economic status does affect students' educational outcomes in the long-term (Schulz, 2005), it is crucial to ensure students to have equal access to technology. The gap between children from low-income families and others may negatively affect one's education pipeline (Blossfeld & Shavit, 1993), and therefore, it is a significant element that we should continue to research. Future studies could focus on the practices and policies that help parents create an appropriate learning environment, including the use of technology, at home for their children (Brooks-Gunn & Duncan, 1997). With the support from government, corporations and school administration, disadvantaged and underserved students can be ensured an education equal to that of more privileged students.

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