The Educational Digital Divide:

A Research Synthesis of Digital Inequity in Education

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Abstract

The Educational Digital Divide describes the differences of access and usage of technology for learning that result in social inequity. Most prevalent between socioeconomic groups, the divide has three levels - access, classroom use, and student empowerment - each the product of the level below. In the first level, inequity is felt in computer, Internet, and software access across the institution, then moves to learning practices in the classroom and ends with students themselves. However, simple equity of technology access will not eliminate this divide as students need to use and leverage technology in similarly transformative ways to enjoy equal benefits.

Introduction

In 1980, Seymour Papert wrote, "we are at a point in the history of education when radical change is possible, and the possibility for that change is directly tied to the impact of the computer" (Papert, 1980, p. 36). Since this statement was made more than three decades ago, Papert's prediction seems to have come to fruition, especially when viewed through the lens of contemporary education. Time spent on computers and the Internet has significantly changed the learning experiences for millions of American students. Students use school technology to consume information and create knowledge in learning activities that are at the same time individualized and collaborative. In the past decade, the infusion of technology into education has radically evolved with the introduction of ubiquitous computing programs, such as one-to-one student laptop programs or bring your own device, where students are not only learning on laptops, tablets, or mobile phones, but also taking their personalized devices with

them wherever they go. Ubiquitous computing programs allow for innovative learning that is not tethered to the classroom or to class time. Yet, as one-to-one device programs are reliant on resources and personnel, a vast majority are found in private schools and public schools that serve high socioeconomic status (SES) communities, which suggests low SES students are not able to participate in this type of anytime-anywhere learning. However, this division of access to innovative practice runs much deeper in American schools. The literature has shown that schools across the United States experience a gap of access to technology and disparate uses of computing for learning that fall directly in line with the socioeconomic divide. This disproportionate access to technology, or the Educational Digital Divide, has been shown to deny low SES students the social and economic benefits inherent in Papert's promise of radical educational change.

The Educational Digital Divide

The Digital Divide was a term coined to describe the gap of access between those who use computers and the Internet and those who do not (Clinton & Gore, 1996). In its most simplistic and deterministic interpretation, the Digital Divide states that access to technology is binary: either people have access or they do not. However, the literature has illustrated that the divide is actually a far more complex issue that has direct ties to societal inequity. The Digital Divide has been shown to be a vehicle by which members of society are located within the stratification of social capital where access to technology not only positions disadvantaged members of society at the bottom of the social spectrum, but also restricts their mobility within that stratum. Theoretical analyses of the divide have shown that technology access is a replicating, if not exacerbating, factor of societal inequities (Brown, 2002; Clark & Gorski, 2002; DiBello, 2005; Servon, 2002; Subramony, 2007; Warschauer, Knobel, & Stone, 2004).

The available literature has shown that resultant inequities of the Digital Divide have been perpetuated within the classroom. Researchers asserted that inequitable access to academic technology exemplifies the role of education in maintaining socioeconomic strata (Ba, Culp, Green, Henriquex, & Honey, 2001; Clark & Gorski, 2002; DiBello, 2005, Kalyanpur & Kirmani, 2005; Light, 2001, Subramony, 2007; Warschauer et al., 2004). High SES students, through access to school supplied Internet enabled computers or personalized mobile devices, attained information literacy and societal influence, whereas low SES students, having little to no access to computers or the Internet, were denied these benefits (DiBello, 2005). The literature suggested that access to technology further entrenches high SES students in their positions within the dominant culture while low SES students are relegated to continued societal oppression (Subramony, 2007; Warschauer, 2003). Thus, researchers cite the Educational Digital Divide as evidence that education in the United States has institutionalized the Digital Divide en route to furthering societal inequality. Further, the literature showed that digital inequity in schools has broad reaching impacts that encompass not only students' access to technology, but also the ways they use technology in the classroom and the resultant implications of that usage.

Hohlfeld, Ritzhaupt, Barron, & Kemper (2008) illustrated the multi-leveled complexity of the Educational Digital Divide in their seminal work on computer literacy. In their model, the Educational Digital Divide has three levels: access, classroom use, and student empowerment. Each of these levels is the product of the one below it. The base level shows that all Educational Digital Divide inequity experienced by students is rooted in disproportionate access to devices, applications, and the Internet. The second level illustrates the disparate ways in which technology is used in the classroom. On the top level, students experience inequitable empowerment opportunities obtained through computer access and the educational uses of technology. The manifestations of inequity progressively narrow as the

Educational Digital Divide ascends through its three levels. In the first level, inequity is felt across the institution. It then moves into the classroom in the second level and ends with the students themselves in the top level.

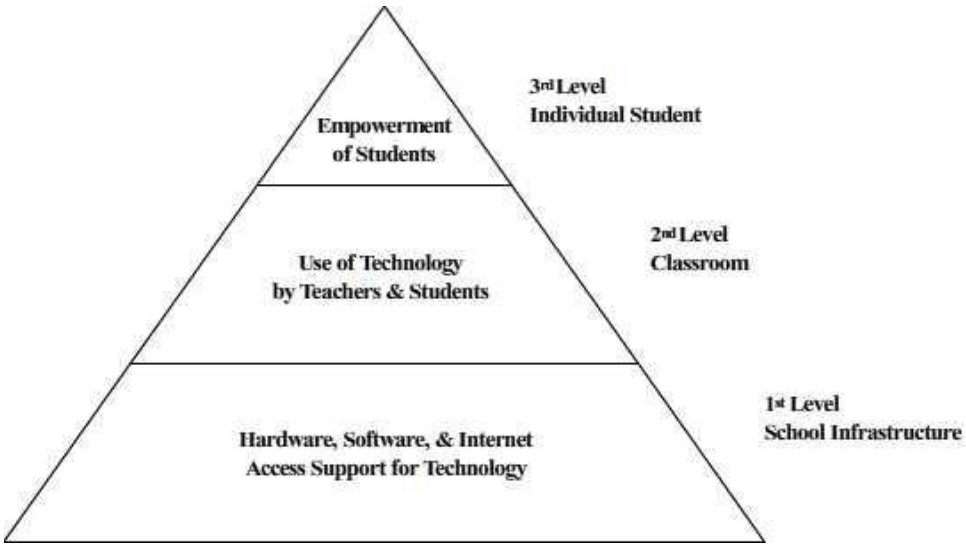

Figure 1. Hohlfeld et al.'s (2008) model of the Educational Digital Divide

Through empirical studies and research syntheses, the literature has shown that students are currently experiencing all three levels of Hohlfeld et al.'s (2008) model of the Educational Digital Divide.

Access to Computers and the Internet

The first level of the Educational Digital Divide states there is a division in access to computing technology among U.S. schools. The division was found in schools' ability to provide and maintain academic technology infrastructure. This level of the Educational Digital Divide impacts students much like the Digital Divide affects social groups in greater society. Students from subverted groups have less access to technology infrastructure than their more-privileged peers. While this division was found between ethnic, racial, and linguistic groups, socioeconomic status was the most cited social group to experience the Educational Digital

Divide (Ba et al., 2001; Clark & Gorski, 2002; Carvin, 2006; Garland & Wotton, 2002; Valadez & Duran, 2007). In their seminal article on the role of socioeconomic status in the Educational Digital Divide, Clark and Gorski (2002) argued that low SES students had the least access to computing because their communities of origin often housed resource poor schools that could not assume the continual costs of educational technology. The prevalence of this focus on socioeconomic status in the Educational Digital Divide literature suggests that any analysis of the manifestations of digital inequity in school must be based in the experiences of low SES students. As such, the remainder of this review concentrates on the implications of disproportionate technology access for low SES students.

This divergent access to technology infrastructure was found to extend both to the quantity of technology access and the quality of the computers students used. Numerous studies showed that low SES students had less access to computing technology, whether measured by student-to-computer ratios (Attewell, 2001; Warschauer et al., 2004) or percentage of classrooms with access to the Internet (Moore, Laffey, Espinosa, & Lodree, 2002; Warschauer et al., 2004). The research showed this level of the divide not only manifested in the quantity of computers and the availability of Internet access, but also in quality. Low SES schools often housed inoperable devices, used out-dated software, and relied on slow and inconsistent Internet connections (Attewell, 2001; Moore, Laffey, Espinosa, & Lodree, 2002; Warschauer et al., 2004).

However, the literature has shown that over the last 15 years the divide in access to technology is actually closing. As a result of grant funding and the ConnectED program (White House, 2013), the standardization of productivity software, the reduced price of applications, and the decreasing costs of devices and broadband Internet, the gap between access for the low and high SES schools has shrunk (Goolsbee & Guryan, 2006; Hohlfeld et al., 2008; Subramony, 2007; Warschauer et al., 2004). Yet, researchers believed this decrease

in access has done little to impact the other two levels of the Educational Digital Divide: classroom uses of technology and student and community empowerment. First, parallel to the Digital Divide found in society, mere access to technology is too deterministic to measure the depth and breadth of digital inequity in schools (Light, 2001). Second, for computers to be transformative, there needs to be equitable educational uses of computers (Mouza, 2008). Just providing access to computers does not equate to similar methods of usage or resultant skills attainment. Lastly, increases in technology access don't address the needs or challenges of low SES schools. In one study, increased access to technology actually amplified existing forms of inequity in low SES schools because the increase was done in isolation of the broader context of the school and the surrounding community (Warschauer et al., 2004). Noting these discrepancies in the impact of technology access on inequity, a majority of researchers have shifted their focus away from access to the ways in which computers are used in the classroom.

Classroom Uses of Technology

The second level of the Educational Digital Divide states there is a disparity in the educational uses of computers and the Internet. Students in low and high SES classrooms use computers in vastly different ways, achieving vastly different outcomes. The measurements of this level of the Educational Digital Divide include: how often students and teachers use technology, for what purpose, and to what degree these activities are integrated into daily instructional activities.

As the first level of the divide – access to technology – heavily influences this level of the Educational Digital Divide, computer use in low SES classrooms was often infrequent. With limited access to devices, software, or the Internet, students and teachers in low SES classrooms found it difficult to consistently engage in meaningful educational uses of

technology (Hohlfeld et al., 2008, Mason & Dodds, 2005a, 2005b). Researchers also found that when technology is available, the lack of reliable equipment and the dearth of technology support personnel resulted in infrequent computer use (Hohlfeld et al., 2008; Warschauer et al., 2004). According to Moore et al (2002) infrequent use of technology in low SES classrooms denied teachers and students the right to leverage the transformative potential of educational computing both on reducing inequity and improving learning.

Yet, frequency of use was secondary to the actual ways technology was used for learning. Researchers found that when school technology infrastructure was equal, high SES and low SES students still used computers in vastly differently ways. High SES classrooms used technology to transform learning whereas low SES classrooms simply used it as an additive (Attewell, 2001; Brown, 2002, Clark & Gorski, 2002; Moore et al., 2002; Subramony, 2007; Warschauer et al., 2004). Teachers in high SES classrooms used computers and the Internet in what Monroe (2001) calls "transformative" learning activities, where students interacted with content through dynamic learning curriculum. They used technology-based activities that focused on creation of knowledge, development of higher order thinking, and deeper understanding of content (Clark & Gorski, 2002). These activities helped high SES students develop skills that better prepared them for the digital global economy (Clark & Gorski, 2002; Swain & Pearson, 2002; Warschauer et al., 2004). Attewell (2001) believed that high SES students who participated in this type of educational computer use not only benefited from the resultant academic skill attainment, but they also learned ways to identify, develop, and leverage social and cultural capital.

Though researchers agreed this model of transformative computer use would be ideal for low SES classrooms, they found that low SES classrooms were using technology in ways that failed to realize these benefits. Most often low SES classrooms used computers to participate in drill and practice activities (Garland & Wotton, 2002). Researchers suggested

reliance on these types of activities, coupled with the dearth of the transformative educational technology learning employed in high SES classrooms, may have actually aggravated inequity, most notably in the widening of the achievement gap (Attewell, 2001; Warschauer, 2004). Brown (2002) went so far as to say that this type of computer use was a tool for behavior management where teachers used repetitive activities to occupy large periods of time in which students were lulled away from interactivity or disruption.

Researchers also claimed computer use in low SES classrooms did not consistently create engaging learning opportunities because teachers often failed to draw upon students' cultural capital. Subramony (2007) identified students' family values, linguistic differences, and diverse backgrounds as frequently absent from the computer activities in which low SES students participated. Garland and Wotton (2002) exemplified this claim in their research on linguistic isolation in technology education. They showed that low SES students in their study, most which came from diverse linguistic backgrounds, participated in Internet activities that only visited English language websites.

This juxtaposition of computer usage between low and high SES students was often the result of teacher preparedness. Compared to their colleagues in low SES classrooms, teachers in high SES classrooms had more formal training and experience (Brown, 2002; Clark & Gorski, 2002; Warschauer & Lepeintre, 1997; Warschauer et al., 2004). Most teachers entered the classroom with more teaching experience, which resulted in better understanding of classroom instruction, pedagogy, curriculum development, classroom management, and assessment. They also completed technology education professional development courses and were versed in computing skills and Internet usage. In contrast, teachers in low SES classrooms were often less prepared to handle the complexities of developing and executing computer based curriculum. Additionally, many of these teachers had been in the profession for less than five years, which was too little time to develop the

instructional skills exhibited by teachers who worked in high SES schools. Moreover, researchers discovered that many teachers in low SES classrooms lacked the cultural knowledge or experience needed to develop engaging and relevant computer learning activities that would draw upon students' cultural and social capital (Attewell, 2001; Brown, 2002; Clark & Gorski, 2002; Subramony, 2007).

As the literature has shown, the convergence of negative factors has created a barrier of technology use for low SES classrooms that is absent in high SES classrooms. Coupled with the divergence of access to school technology infrastructure, this barrier has created a divide of equitable use of computing in U.S. classrooms. The literature has shown this divide not only has impact within the classroom, but also lasting implications on students and their communities.

Student and Community Empowerment

The third level of the Educational Digital Divide further narrows the focus of inequity to those who are directly impacted by it: the students. Research has shown that technology and educational computer usage can provide students with tools to for self-empowerment, yet, low SES students are not realizing this potential. Holhfeld et al. (2008) described this inequity of student empowerment as whether "[students] know how to use [technology] for the betterment of their quality of life" (p. 1650).

Life skills development was the most common area of empowerment found in the literature. In describing these skills, researchers claimed that students who participated in dynamic computer use in schools developed critical competencies including academic content knowledge, depth of understanding, and problem solving skills (DiBello, 2005; Pearson, 2001; Warschauer, 2003). Specifically, researchers identified technology skills as the most prominent means of student empowerment. Students who utilized school technology to attain

and develop technology skills were better "socialized into, and prepared for, the tech-heaviness of contemporary society" (Clark & Gorski, 2002, p. 29). The literature further suggested that divergent technology proficiency had long term consequences for low SES students in the form of gaps in future earnings tied to technology skills, gaps in civic involvement for those not proficient with Internet use, and gaps in influence on equity and civil rights issues (Clark & Gorski, 2002; DiBello, 2005; Subramony, 2007).

Some researchers claimed that the deepest impact of digital inequity on students came in the form of social capital development. When discussing technology use in education, Warschauer (2003) defined social capital as the accrual of benefits from personal relationships and memberships in social networks. Researchers believed that low SES students missed the opportunity to leverage computers and the Internet to create and cultivate social networks within their schools and communities, thus denying them digital tools to organize and facilitate social mobilization (Clark & Gorski, 2002; DiBello, 2005; Light, 2001). They noted that high SES students developed greater social networking skills through their educational technology use, which widened the gap of social capital.

In line with social capital development, researchers extended the scholarship of the third level of the Educational Digital Divide to include the impact of inequity on students' families and communities. Vail (2003) claimed efforts to address any or all levels of the Educational Digital Divide will fail as they don't account for the technology access in students' homes. He believed that to truly address educational technology inequity, educators must find ways to extend learning to students and their families. Clark and Gorski (2002) echoed these claims by stating equitable technology education, should it exist, would have to include collaboration efforts with families and communities to draw technology learning outside of the classroom. Other researchers concluded that the third level of the Educational Digital Divide denied tools for civic involvement and community development, which they

claimed could reduce the prevalence of societal inequity (Clark & Gorski, 2002; DiBello, 2005, Garland & Wotton, 2002; Warschauer, 2003; Warschauer et al., 2004).

Summary

The Educational Digital Divide is a complex issue of inequity that manifests in three areas: access, usage, and empowerment. A chasm of access to school technology infrastructure exists between low SES and high SES students, where low SES students do not have access to the computing and digital communication resources requisite for meaningful educational technology use. Yet, the divide in educational technology use itself is representative of educational digital inequity. Students in high SES classrooms have been shown to use devices in ways that encourage cognitive development, creativity, and deeper understanding of content. This divergence of use has resulted in a gap in learning outcomes. Low SES students who have not had the opportunity for meaningful educational computer use have been unable to leverage those experiences for personal empowerment, thus replicating social inequity.

Yet, there was an area of scholarship noticeably absent from the Educational Digital Divide literature: ubiquitous computing. What if every low SES student was given equal access to technology for use at home and at school? Would this reduce the Educational Digital Divide? The literature suggested that one-to-one student laptop programs would simultaneously reduce and perpetuate the divide. By providing all students equal access to the technology, the first level of the divide – access – would be significantly reduced. However, equitable usage of computers would not automatically emerge. Instead, research shows that laptop use and the resulting student empowerment would continue to diverge.

This dearth of literature presents an opportunity for this research into existing ubiquitous computing programs in order to identify the breadth of student learning attained through ubiquitous computing and to identify which of those learning outcomes had the

greatest impact on low SES students. By identifying the breadth of student learning outcomes – both academically and non-academically – researchers and practitioners could have an empirical basis for program assessment and improvement. These data would provide views into meaningful computer usage and realistically attainable learning outcomes that could influence laptop programs in low SES communities, thus addressing the second level of the Educational Digital Divide. Moreover, by identifying student learning outcomes that have the greatest potential impact on low SES students, program administrators could tailor their programs to specifically target the third level of the divide: the use of computer skills and knowledge for student and community empowerment.

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