Ubiquitous Educational Computing and Learner-Centered Instruction: A Likely Pair

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> *Education either functions as an instrument which is used to facilitate integration of the younger generation into the logic of the present system and bring about conformity or it becomes the practice of freedom, the means by which men and women deal critically and creatively with reality and discover how to participate in the transformation of their world.*
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> —Paulo Freire.

1 Overview of Ubiquitous Computing and Learner-Centered Instruction

Ubiquitous computing can be defined as an environment where computers are thoroughly integrated into our lives and daily activities. From laptops to smartphones to tablet PCs, more people than ever before have constant access to computers and the Internet. Although access to these technologies is limited by financial resources, the cost of being "connected" has fallen in recent years to make ubiquitous computing a reality for a quickly growing number of people.

As public interest in and acceptance of the benefits of technology for improving our lives increase, schools are beginning to follow, by increasing the amount of advanced technologies available for students and teachers. Many schools are striving for a more ubiquitous computing environment through one-to-one (1:1) computing, which refers to an environment where all students have or are provided computers for their own personal use. A 1:1 environment holds promise as an environment to support a learner-centered instructional approach (Cornelius-White et al.2012; Fleischer 2012).

Learner-centered instruction refers to trusting and empathizing with students, having high expectations, believing teachers are facilitators more than direct imparters of information, fostering collaboration more often than individual and competitive work, supporting differentiated (developmentally appropriate) and self-directed student learning (Cornelius-White and Harbaugh 2010). It is essentially the practice of sharing choice and control with learners (McCombs and

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Whisler 1997), so that they have the freedom to learn (Rogers 1969). In an effective 1:1 environment, students are using technology to create, synthesize, and evaluate and other activities that require them to be active, hands-on learners. An effective 1:1 environment requires that teachers are facilitators, providing and guiding students through opportunities to attain and master knowledge and skills necessary for interdependence in the twenty-first century.

Some have raised concerns about accepting a philosophy that having more technology in schools leads to a better education (Weston and Bain 2010). There are also several issues with choosing which technology best suits the students' needs and then implementing that technology. Other problematic issues raised through a goal of ubiquitous computing related to access (Rockman et al. 2000). Not all students have access to computers or the Internet outside of the school building. Another concern of particular importance is that technology was not intended to and cannot replace teachers. Teachers still, regardless of the amount or types of technology in the school, need to maintain facilitative relationships with students, guiding them through the learning process. Indeed, research by Motschnig and colleagues has shown how technology-enhanced environments can leave space for even richer in person interactions and encounters (Motschnig-Pitrik and Mallich 2004; Motschnig-Pitrik 2005). Regardless of a teacher's expertise with a particular technology, the teacher has an opportunity and responsibility to guide a student's learning experiences in an ethical and responsible way using the technology as a means to the end that is the student's development. Each of these and other emerging issues needs to be considered when incorporating new technology into the school.

One of the most pressing questions facing educators today is the efficacy of the "flipped classroom" model (cf. Zappe et al. 2009). In this instructional model, a traditional, transmission model of instruction is flipped or inverted. In the traditional, transmission model, the student passively receives instruction in the classroom, while the teacher delivers instruction through lecture, demonstration, or some other teacher-centered means, followed by the student going home to become active with a homework assignment in an environment devoid of the teacher. In the flipped version of this instructional delivery method, the student is asked to receive instruction outside the classroom, often with the help of technology, and when the student returns to the classroom, she has the benefit of the teacher as facilitator for the active portion of instruction. The flipped classroom model has increased in popularity over recent years. However, educational researchers need to be careful to continue to have a voice in determining the efficacy of this model.

Another concept revolutionary to education is the increased accessibility and omnipresence of online courses. This phenomenon, combined with the flipped classroom or other models of blended instruction, provides researchers and practitioners challenges to find and support best learner-centered instructional practices. What is the role of the teacher in the flipped classroom model when the teacher's responses are intentionally omitted from the conversation, for example, during the lecture or demonstration phase of the model where the student is unable to ask a live and present teacher for clarification or further explanation? Derntl and Motschnig-Pitrik (2005, p. 128) suggest that "technological advances must go

hand in hand with improved interpersonal skills and attitudes of educators." Do teachers' instructional choices in technology-rich environments build bridges between students and facilitators of learning within the community and, if not, then how can we, as educational leaders, offer choices that do build these important bridges? As a start to answer these and many other questions emerging around ubiquitous computing and students' usage of computers for learning, we need to look to what the research community is already doing. The synthesis of this research described in the remainder of this chapter begins that important work.

2 A Meta-Synthesis of the Research on Ubiquitous Computing in Education

The Ozarks educational research initiative (OERI), a collaborative partnership between 16 member school districts in the state of Missouri, requested that the Institute for School Improvement at Missouri State University conduct a "meta-analysis" of research on 1:1 technology initiatives to inform member districts and to help guide related research activities for the project (Cornelius-White et al. 2012). The authors identified and analyzed four systematic reviews of research, which included 131 total unduplicated studies, focused on 1:1 educational technology; five additional systematic reviews of research that included but went beyond 1:1 educational technology; and 24 other reviews of 1:1 technology initiatives in elementary and secondary education. Findings and conclusions of these selected reviews were coded and analyzed according to their strength of evidence. Those reviews with findings coded as moderately or strongly supported came almost exclusively from the group of four focused, systematic reviews (Penuel et al. 2002; Penuel 2005; Bethel et al. 2008; Fleischer 2012).

Generally, laptops, rather than other kinds of computing devices, have been the focus for systematic reviews of 1:1 technology research through 2011. These reviews show that writing is the area of student achievement with the largest and most consistent positive impact in 1:1 initiatives compared to other student outcomes. A small to medium, but consistent, effect size ($g = 0.30-0.35$) for writing improvement was found across multiple studies. Additionally, computer usage and literacy are clearly improved in environments where students have generous access to computers. Although this finding was clearly supported across studies, inconsistent reporting made determining an effect size impossible. The most consistent findings for implementation impact in 1:1 educational technology initiatives include provision of thorough, staged professional development, infrastructure and technical support, district–school–teacher leadership and collaboration and the need for ongoing research and evaluation of 1:1 initiatives. Again, although these findings were consistently supported across studies, inconsistent reporting prevented us from providing a magnitude of effect. Very little information, none of it systematic or experimental, was found with regard to cost-benefit analysis or other funding concerns.

3 Research Focused on Ubiquitous Computing and Learner-Centered Instruction

Results of the meta-synthesis further showed that 1:1 implementation (one computer for each child) was more successful when the teacher employed learner-centered strategies, such as fostering cooperative and self-directed projects, inviting questions, and other co-regulated learning endeavors, which, in turn, then led to a more learner-centered climate. The synthesis found support that professional development will be more successful if it addresses teacher beliefs about instruction and technology, includes relevant hands-on training, and involves collaborative or cooperative learning among teachers and is accompanied by sufficient technical support and collegial assistance when needed. We also found that through effective professional development, teachers' beliefs tend to change toward those that might be considered more learner-centered.

Employing learner-centered strategies during 1:1 implementation can also lead to twenty-first century skills, such as the ability to work independently, think critically, complete large and/or complex ventures, and work collaboratively with peers. These domains have traditionally been goals for learner-centered instruction, representing a more holistic and progressive view as compared to a focus on traditional achievement alone (Rogers 1969; Motschnig-Pitrik and Mallich 2004; Cornelius-White 2007). Although the meta-synthesis found that research in these areas is characterized by less clarity, rigor, and consistency of findings, these claims have been consistently supported at moderate levels.

For example, it was shown in several studies that students' collaboration with teachers, other students, and/or people in the community was improved through 1:1 initiatives. Similarly shown is that students conduct more research, maintain attention on longer-term projects, know more available resources for consultation, and improve their organizational skills as a few studies have supported these outcomes.

When in ubiquitous computing environments paired with facilitative teachers utilizing learner-centered instructional practices, students learn how to learn, perhaps the most important outcome from Rogers' (1969) original perspective. These students are developing critical and creative thinking skills that are important in career development. When students are presented with both authentic problems to solve and the tools to solve them, from the computing resources to the skills of how to effectively use these resources, the students are deeply engaged in important experiential learning (Rogers 1969). The information literacy skills that students develop in effective ubiquitous computing environments will be invaluable in and out of the work place. As an additional result and benefit for teachers and students, working with computer-skilled students may lead to situations of mutual learning and co-actualization for learners of all ages and levels.

4 Conclusion

Initiatives for a 1:1 technology-enhanced learning environment have become increasingly common in K-12 education. A meta-synthesis of research on 1:1 technology initiatives aimed to address learning issues, synthesizing available literature while attending to the quality of research for each of the three broad domains: student outcomes, implementation, and funding issues. This meta-synthesis identified and analyzed four systematic reviews of research, which included 131 total unduplicated studies, focused on 1:1 educational technology. Results of the analysis showed that 1:1 implementation was improved when learner-centered strategies were employed, which, in turn, can lead to a more learner-centered climate. Likewise, the research found that employing learner-centered strategies during implementation of 1:1 computer initiatives leads to improved twenty-first century outcomes or skills.

The person-centered community, including counselors, educators, and researchers, can establish their position in the field of ubiquitous educational computing by finding ways to support implementation of ubiquitous educational computing consistent with the Learner-Centered Psychological Principles (American Psychological Association 1997). Specifically, research needs to investigate the roles of school personnel empathy, unconditional regard, challenge, and other key learner-centered relational variables (Cornelius-White 2007) in such technology-rich environments. Additional research should also answer practical concerns such as how to provide a sustainable infrastructure as technology is constantly advancing. With these and similar issues being addressed by researchers, the person-centered community will be in a strong position to manage the inevitable increase in technology in our schools in ways that are consistent with the values of the community.

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