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Bridging 21st Century Gaps: An Essay Review of Mehlenbacher's *Technology and Instruction*

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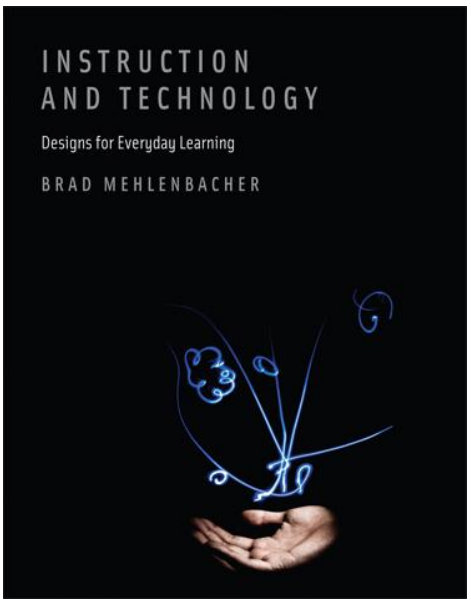
Historians of computers mark the beginning of the age of electronic digital computing with Electronic Numerical Integrator and Computer (ENIAC) which was used during the Second World War (Ceruzzi, 2003). In the following decades, advances in computer hardware and software slowly (but with increasing speed) resulted in devices that are what we recognize as general computing devices such as desktop and laptop computers. Today, the term information and computer technology (ICT) is commonly used to identify the collection of computers, peripherals, and networks available in homes, schools, and workplaces. These devices can be used for a wide range of purposes, and a single device can be customized to accommodate many users'

needs (this may require writing the necessary program or purchasing the necessary program from someone else). ICT devices arrived in schools soon after they were first marketed for consumers, so the computer age in most schools started in the late 1970s. Despite more than three decades of effort to adopt computers in education (and adapt education to computers), many scholars and observers have noted that much curriculum and instruction appears now as it did prior to the arrival of computers in schools (Abadiano & Turner, 2007; Christiansen, Horn & Johnson, 2008; Plauff, 2004; Wepner, Bowes, & Serotkin, 2007).

Cuban (1986) suggested that computers were following a well-established pattern of electronic information media in education that had been observed throughout the 20th century. First, with much fanfare, advocates promise education will be transformed by using the technology. Second, research (usually dubious in nature) supports those advocates' claims. Third, the technology is introduced to schools. Finally, the technology falls into disuse. By reviewing data collected when radio, movies, and television followed this pattern, Cuban identified three factors associated with the failure of each to transform education as promised in the initial rhetoric: (a) insufficient access to the technology, (b) inadequate teacher training, and (c) a lack of curriculum materials. In the three decades educators have been working with computers, those factors have been addressed. Schools in the U.S. have access to computers and broadband Internet connections (Cavanaugh, 2008), teacher training programs are on-going (Wells, 2007), and curriculum standards have been provided by professional organizations (National Educational Technology Standards Project, 2007).

Despite all of the work ensuring educators have access, training, and curriculum materials, many educators continue to struggle to use ICT; and curriculum and instruction have not been systemically transformed. Wan, Fang, and Neufeld (2007) observed that "while interest in technology-mediated learning has grown rapidly in recent years, a comprehensive



theoretical framework [of] relevant constructs and their relationships has not yet emerged" (p. 184). Several other scholars have concluded that education practitioners and education scholars are in need of new theoretical frameworks to facilitate the transformation of curriculum and instruction so that it reflects the role of ICT in greater society (Gilbert, 2007; McDougall & Jones; 2006; Mishra & Koehler, 2006; Person & Somekh, 2006; Schlanger, Farooq, Fusco, Schank , & Dwyer, 2009; Somekh, 2004; Vrasidas, C., Zembylas. M. & Glass, G. V, 2009). In *Instruction and Technology: Designs for Everyday Learning*, Brad Mehlenbacher seeks to provide a framework to fill this gap. Although the audience explicitly named is researchers and practitioners who work in technology-based distance learning environments for higher

education populations, the book does outline the modern problem of curriculum design and instructional delivery for all educators regardless of the populations they teach or they research. The framework will also help bridge the gaps between the theories developed by education scholars, the models used by education practitioners, and the systems designed by education technologists.

Judging the Book by Its Cover

My copy *of Instruction and Technology* was on a desk in my classroom among the laptops, microphones, and drums my physics students were using to measure the speed of sound on a lab day early in the school year. The principal of our school walked in and picked up the book. He flipped through the many dogeared pages and noted the copious notes I had taken in the margins while I finished working with my students to be sure they understood how to analyze their data. As he flipped through the pages, I noticed he was increasingly uninterested in the book. After I dismissed my students, he commented, "I thought that book was going to tell me something good."

I explained that the book contained the results of the author's very thorough review of peer-reviewed literature and that data had been used to identify and explicate components of a framework for curriculum and instruction. I pointed out that although the intended audience was professionals who are interested in designing web-based instruction (WBI) for higher education, it included many relevant applications to both gathering data related to ICT use in our school and assessing ICT-based instruction in our school. My principal rolled his eyes, set the book down. He asked me what I thought should be included in the year's in-service program to help teachers in our school use technology in their classrooms. When I picked up the book to point out important points made by Mehlenbacher that have important implications for K-12 educators, my principal interrupted me and said, "No, we need something teachers can actually do."

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Education is a human activity in which the scholars who study the activity and the practitioners who engage in the activity are different people, working in different institutions, and whose individual and

institutional goals are different. These differences frequently result in practitioners and scholars viewing each other with suspicion. In the 21st century school, there are further suspicions between those who are responsible for installing and managing ICT systems in schools and both practitioners and scholars as well. Until these suspicions and the resulting gaps separating the work of each groups are resolved, education will continue in the current state: scholars' work (both scientific discoveries and epistemological thinking) will be ignored by practitioners; practice will vary according to political whim rather than emerging understanding; and technological systems will be installed, grow obsolete, and be replaced without affecting instruction.

The framework proposed by Mehlenbacher does much to fill in the gaps between education scholars, practitioners, and technologists. It is a book written for scholars. The author articulates a complex problem with clarity, provides data to support a solution, and comments on the implications of the solution. This is typical of the work done by scholars, and in this case it is well done. It is unfortunate that the presentation, which is necessary for the identified audience of the book, contributes to the suspicion that practitioners—at least the principal who judged my copy of the book after flipping through the pages—have of scholars. It is unfortunate because the author's view of the curriculum and instruction problem for WBI in higher education also articulates a coherent and insightful view of the complex problem of K-12 curriculum and instruction. The framework proposed as a solution to the problems has applications to research and practice for K-12 populations as well.

A Complex Problem Explained

Many education practitioners seek a professional literature that outlines a course of action; they reason that through using experts' vocabulary and following experts' gait, they can become expert. Mehlenbacher avoids contributing to this too simplistic approach to education. When describing the purpose of the book, he indicates "rather than providing prescriptive recipes for creating online instruction or simply applying methods form human-computer interaction and usability research to the study and evaluation of online learning environments, a long-term multidisciplinary research investigation is required" (p. xv). In this, Mehlenbachler both alludes to the groups whose work stands to be transformed through the application of his framework and he hints at the complexity and multidimensional nature of the solution.

In the chapters that lead up to the framework promised in the subtitle, Mehlenbacher establishes the context of modern curriculum and instruction. This includes reviewing how ICT has been shown to influence human cognition and human culture, defining the different learning worlds that are observed in the modern world, reviewing the multidisciplinary nature of ICT-based research, and identifying several theories that scholars use to predict and explain observations in ICT-rich learning environments. In this context, readers understand the assumptions Mehlenbacher makes about instruction, ICT, and the creation of modern learning environments. Through this maze of ideas, Mehlenbacher connects with concerns I hear from my colleagues who are scholars, my colleagues who are practitioners, and my colleagues who are technologists, and the concerns that I read in the literatures for each of these groups. It is likely that

individuals in each of these disparate groups will begin to see themes that they resonate with and that connect their work beyond the traditional boundaries separating scholars, practitioners, and technologists. Scholars will find their research problems are more complex than those faced by previous generations. Practitioners will find that their students live in a world that did not exist previously and the skills necessary for participating in that world are different from those of previous generations. Technologists will find their tools and practices do not exist in a vacuum; technology systems affect how humans interact with information and with others.

ICT Affects Humans

Mehlenbacher begins his book with the observation "[e]merging technologies are rapidly forcing us to rethink and repurpose everyday instructional needs and contexts for interacting with information, with ourselves, and with others" (p. 1). For decades, scholars have been studying the effects of information and computer technology on humans, and a recurring theme in the field is the non-neutrality of ICT. According to the principle of non-neutrality, the ICT used by individuals and groups affects how problems are framed, posed, and solved by those people. ICT also affects human cognition and how cultures define and use information (McLuhan, 1964; Ong, 1980; Seldes, 1960).

After articulating a version of the non-neutrality of ICT theme, Mehlenbacher summarizes his position, and articulates the purpose of the book: to create a framework within which instruction can both be designed and researched. That framework must reflect the non-neutrality of ICT. Mehlenbacher states "much can be gained in terms of theory building if we resist the urge to proceduralize or draw neat causal conclusions about our relationships with technology, our learning environments, and the various instructional contexts within which we find ourselves" (p. 19). From this, the construct of *everyday learning* is defined as the diverse formal and informal learning situations that characterize the modern world. The situations are changing in response to emerging learning needs for the workers in the modern economy and also in response to rapidly evolving ICT.

Although recognizing the non-neutrality of ICT as an assumption that scholars must identify in their research, it is an example of the "too theoretical" approach that causes practitioners to view scholars with suspicion. By including it in this book, Mehlenbacher reminds all who are involved with education that information and the technology we use to access and create and share information are part of a greater system. This greater system has been described as informatics (Beynon-Davies, 2009) which includes three subsystems: (a) the social actions (such as instructions or the details of business transactions) individuals seek to communicate, (b) the system used to encode those actions (such as language), and (c) the technology systems used to store and transport those actions (such as writing systems or computer networks). Scholars, practitioners, and technologists who ignore the mutual and simultaneous effects between humans and information and technology do simplify their problems, but this simplicity comes at the expense of efficacious work in any of those domains.

Learning in the Modern World

The need to be a life-long learner has become obvious to many observers (Casner-Lotto & Barrington, 2006; Karoly & Panis, 2004; Thornburg, 2002). Mehlenbacher

(2010) reiterates this theme, and defines three learning worlds that are well-documented in the large literature focusing on ICT-rich instruction. Because he writes for an audience of professionals in higher education, the learning worlds he describes were selected because they are the most important for those populations. However, themes Mehlenbacher expands on have equal application to the learning worlds experienced by K-12 populations. First, ICT is affecting learning in each of these worlds, and the effects of ICT are blurring the distinctions between learning in each world that were observed before ICT became ubiquitous. Second, previously useful ideas about technology in learning, including themes such as productivity and efficiency, are no longer meaningful in the world of ill-structured information and learning problems.

A Large and Diverse Research Tradition

Throughout the history of educational technology a large and diverse professional literature has developed, and it has focused on many aspects of ICT-rich teaching and learning. Mehlenbacher views this literature as a rich source of data to inform the practice of ICT-rich curriculum and instruction, and he describes a large sample that was reviewed to elucidate his proposed framework. His analysis leads to three conclusions regarding the state of education technology research: First, there are multiple theoretical frameworks that have been used to describe ICT-rich e-learning in higher education populations. This appears to contradict those scholars (Gilbert, 2007; McDougall & Jones; 2006; Mishra & Koehler, 2006; Person & Somekh, 2006; Schlanger, Farooq, Fusco, Schank , & Dwyer, 2009; Somekh, 2004) who have concluded such theory is missing. Second, "various conversations about technology are playing out just [out of] earshot of one another" (p. 108). He continues, "[w]e lack both a shared understanding of our primary objects of inquiry—that is, learning, technology, and instruction—and a language for comparing and contrasting visual representations of theoretical arguments" (p. 108). This suggests the gaps observed between scholars, practitioners, and technologists are observed within those groups as well. Third, mining the research published between 2000 and 2006 (the chart in the appendix referencing the articles exceeds 40 pages) suggests common elements in these multiple theoretical frameworks, and those are used in the framework he proposes. Mehlenbacher concludes that the complexity and diversity of the research conversations obfuscate the themes and elements that will lead to the transformation of curriculum and instruction because of ICT which has been observed is other aspects of modern life.

Education Has Become a Wicked Problem

Wicked is a term that has been applied to various problems in the social sciences since the 1970s. These problems are complex and lack definitive formulation, stopping rules, and systems for evaluating solutions; further the solutions to wicked problems cannot generally be transferred to other situations (Rittell & Webber, 1973). Because of these characteristics, the methods of problem solving and planning that are effective in science and engineering situations, and that many have attempted to apply to education, are unsatisfactory.

Mehlenbacher suggests that curriculum and instruction in the modern world is a wicked problem. Further, he reasons that the failure to recognize the wicked nature of education

problems and the attempts to apply science and engineering solutions to instruction have contributed to the suspicions that separate scholars and practitioners and have posed an obstacle to the predicted transformation of curriculum and instruction by ICT. He concludes, "reviewing the enduring dichotomy between what is defined as science [and] non-science has revealed how this dichotomy has served as a powerful backdrop for current divisions between theory and practice" (p. 191). Further, he concludes, "[b]y highlighting similarities between the activities of theoreticians and practitioners, I have outlined a useful alternative that is responsive to wicked contemporary problems…." (p. 191) His useful alternative is a framework that fills the void between the various professionals involved with ICT-rich education.

Framework

Mehlenbacher chose the term framework to describe his work as opposed to theory or model by noting that a framework "aims to describe the fundamental structure underlying a concept, technology, or system" (p. 194). In this choice, Mehlenbacher places the framework between the theories of scholar and the models of practitioners. Thus positioned, the framework can serve both scholars as they engage in design-based research (Barab & Squire, 2004) and practitioners as they seek to transform uncritical practice into those who engage in theory-driven praxis (Levy, 2003). In further defining frameworks, Mehlenbacher notes they have generic dimensions that are used to explain and predict particular instances in which the framework is applied.

The dimensions of the framework emerged from a review of e-learning literature published between 2000 and 2006. By including these dimensions in the space separating and connecting scholar and practitioners, Mehlenbacher is proposing that scholars focus on how factors related to these dimensions affect learning and that practitioners focus on how these dimensions can be manipulated in a situation to accomplish educational goals. Although Mehlenbacher does comment on what he calls *ideal experiences* within each dimension that appear to have contributed to transformative practices in WBI compared to face-to-face instruction, he does make clear that the purpose of the framework is to advance inquiry and promote curriculum and instruction design rather than to specify practices. The five dimensions in the framework are (a) learner background and knowledge, (b) learner tasks and activities, (c) social dynamics, (d) instructor activities, and (e) learning environments and activities.

Many of the factors included in the *learner background and knowledge* dimension have been incorporated into constructivist learning theories and classroom practices based on these theories for decades (Brooks & Brooks, 2001; Sandholtz, Ringstaff, & Dwyer, 1997). Biological factors include race and handicapping conditions, previous personal and educational experiences, and sociocultural experiences and abilities. Mehlenbacher notes that learner background in the 21st century includes a variety of literacies, some of which were not important for previous generations. Examples of these include computer literacy and domain literacy, each of which have expanded with access to rapidly evolving ICT and the rapidly expanding access to information available through that ICT.

Because there are increasingly complex and wicked problems faced by society and because there is increasingly sophisticated ICT to facilitate communication about those

problems, Mehlenbacher reasons that educators must revise *learner tasks and activities* to reflect these new realities. In addition to identifying extant instructional frameworks that appear to be aligned with what Mehlenbacher perceives to provide ideal learner tasks, he provides frameworks that can be useful for understanding the cognitive or communicative goals of ICT-mediated learner tasks. He remains true to the goal of writing for professionals interested in creating WBI for higher education, but the learner tasks are similar to those that are recommended in the professional literature for other educators. Also, the ideas and models used to define and explicate this dimension of the framework can be applied to all instructional situations.

Much instruction has been traditionally conceived as a one-way communicative activity; teachers delivered instruction to students and interaction between teacher and student was limited and interaction among students was perceived as ancillary to the instruction. ICT-mediated communication is changing both the communication tools available to teachers and students and also the ubiquity of these tools, especially among young populations (Palfrey & Gasser, 2009; Tapscott, 2009), and students' expectations of communication between teacher and student and among students. Mehlenbacher (2010) points out that these changes make *social dynamics* an important dimension in his framework.

Given the changes that result from the use of ICT in learning situations, and the changes that ICT will exert on the other dimensions of Mehlenbacher's framework, changes in *instructor activities* are to be expected as well. This dimension includes activities related to planning and preparing content (an activity perceived as being increasingly collaborative because of the advantages of ICT), delivering and managing content, and interacting with and providing feedback to students.

Especially for those who work in WBI, the creation of *learning environments and artifacts* is a new aspect of education. Consequentally, it is the dimension with which scholars and practitioners have the least experience, and the one for which they require the greatest assistance from their technologist colleagues. Clearly, this is the one dimension of Menhelnacher's framework that is most directly affected by the ICT that is available to populations of students and that is used to create online learning environments. In addition to reviewing how the traditional classroom context is defined and how that knowledge can be applied to online learning environments, Mehlenbacher describes the usability research that is familiar to educational technologists as an important component of this dimension that will connect technologist to scholars and practitioners.

Implications for Educators

It is clear that Mehlenbacher was writing for the audience he defined, and that audience comes to the book with a good deal of expertise in the field. This audience will find that the detail and the copious references to the research are necessary to assess the credibility of the framework. That detail will serve the audience well and, I expect, they will find it a useful resource for both generating fertile research agendas and for designing WBI environments. It is also clear that that same detail will result in scholars and practitioners from more diverse fields of education concluding that the framework has few connections to their area of expertise, and thus they are likely to avoid

the book. The story of my principal's interaction with the book may unfortunately be typical of the reaction to the book by K-12 practitioners.

An indicator of good scholarship is that those who interact with it are left with new, interesting, and important lines of inquiry. An indicator of excellent scholarship is that those lines of inquiry cause others to think deeply about their work; excellent scholarship in the social sciences causes others to understand the human and sociocultural context of their work, challenge their assumptions, and seek out unanswered research problems. In education, excellent scholarship must also cause practitioners to understand their work. In ICT-rich education, this milieu is further complicated by the ICT and the professionals who support the ICT. The complexity and detail is a necessary but unfortunate aspect of this scholarship and cannot be reduced or minimized.

As a professional who is an active scholar and an active practitioner as well as an active technologist who seeks to be a leader in ICT-rich education, especially for K-12 populations, I have multiple perspectives from which to consider the framework. I join Mehlenbacher and other scholars who feel that ICT-rich curriculum and instruction have not been implemented in a manner promised by the rhetoric over the last few decades. I also join Mehlenbacher in lamenting the lack of a framework providing a common vocabulary, common questions to direct and evaluate evidence, and a common system for validating propositions. These are necessary if we hope to transform scholarship and practice to reflect the promised role of ICT in society. As with all scholarship, this framework is rich with assumptions, its application will depend on many factors, and it is likely to be challenged as we understand it more deeply. It is unusual scholarship, however, in that it can be widely applied; it is the responsibility of our communities to use this scholarship to design educational systems capable of making their vital contribution to modern society.

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Gary has extensive experience teaching teachers. He has been an adjunct instructor for the University of Vermont, Castleton State College, College of St. Joseph in Vermont, and he has served on the faculty of several education institutes.