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The Relationship between Technology and Design in Educational Technology Research and Development: A Reply

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I will be brief in my reply to Richey's response (this issue). Of the many topics that Richey discusses, I will focus on just one: the role of technology in educational technology research and development. In her article, Richey advances a fundamental misrepresentation of my position, as it is delineated in my article in this issue and in previous articles (Kozma 1991, 1994a, 1994b). According to Richey, I suggest that the field of educational technology research and development will grow "only when research, product development, and academic programs focus on *technology-driven* instruction and learning" (p. xx) [emphasis added]. She goes on to say that I suggest that "media research should have a *paramount, if not exclusive,* role in the field's research agenda" (p. xx) [emphasis added].

I find these techno-centric representations to be a common and unfortunate misconception of my position, particularly among those researchers that adhere to the tradition ISD position. Further, it is difficult for me to understand the origin of this misconception when I explicitly articulate a position otherwise. Let me quote from my own article (this issue): "The design of learning materials and environments is the core of our field" (p. xx). I go on to say that, "If we understand the media we use, they can inspire our creativity and enable powerful designs" (p. xx).

I believe our research focus should be on the nexus of these two things: design and technology—media *and* method—not just one or the other. Neither alone accounts for all the variance in our research findings. Neither alone is sufficient to sustain our field. It is the interplay of the two within the learning context that should be the focus of our research and theory. This is a position I stated in my response to Clark (Clark, 1983; 1994; Kozma, 1994b) and it is a position I will reiterate here.

I do not push technology to the exclusion of design. Instructional design—or as I prefer, the design of learning environments—is essential to our field.

On the other hand, I feel that there is a large number of traditional educational technology researchers who focus only on design. Clark (1983, 1994) and others contend that it is method not the medium that accounts for learning. They disparage or ignore the role of technology in our field. To them it is just an inert, passive vehicle by which method is delivered. To hear Richey (this issue) talk, it sounds like our focus of our field is exclusively design. In reading her article, it is difficult to distinguish between our field and other design sciences, such as organizational psychology, behavior management, or program evaluation. What distinguishes our field from these?

I believe that what distinguishes (or what *can* distinguish) our field is that we *design with technology* and our research looks at (or should look at) the relationship between *design and technology*. I promote technology within our research agenda to counteract a position that focuses exclusively on design. I do not view technology as paramount but I do want to reintroduce, to re-legitimize, to understand the "T" in the field of ET.

I propose that the primary goal of our research and theory should be a deep consideration of the bi-directional, transformational, often-confounded relationship between design, the capabilities of medium which enables them, and the ways these designs, so enabled, address the needs of their target communities. I propose that we examine the ways in which our designs are enabled and constrained by technologies with different symbolic and processing capabilities. We should explore how new technologies allow us to invent new designs. We should examine how these new designs address and solve (or not) important learning problems or create new learning opportunities in the real world, whether the "real world" is the classroom, the living room, the business office, or the shop floor.

Historically, the introduction of new technologies has often made major changes in a field and, in turn, changes in how researchers in these fields understand their domain. The field outside of ET that is most familiar to me is chemistry. I am not a chemist, but in working with chemists and software engineers to design learning environments that help students understand chemistry (Russell & Kozma, 1994; Kozma, Russell, Jones, Marx, & Davis, 1996; Russell, Kozma, Becker, Suskind, in press), I have examined the roles that representations and tools (i.e., media and technology) have played in advancing chemists' understanding of their field (Kozma, Chin, Russell, & Marx, in press). Throughout the history of chemistry, the invention of new technologies has allowed chemists to do new kinds of R&D that have lead to new understandings about chemistry and the invention of yet other technologies. Over the past two centuries, this recursive relationship between technology, R&D, and understanding has made profound changes in what chemists do and fundamental changes in the understanding of the nature of matter and reactions. Technology has played an important role in moving chemists from an understanding of matter based on its surface or molar physical features to one based on the underlying composition, structure, and reactivity of molecules.

We are in a unique position in the history of our field (in human history, for that matter). We have at our disposal what Herb Simon (19xx) calls a "once in a century invention": the computer. Simon was impress with the capabilities of the computer in 19xx and these capabilities have increased in the short time since he made this statement. Even the most humble computers on elementary students' desks are significantly more powerful than the computers that took astronauts to the moon only 25 years ago. Soon computers will integrate cable video, telephony, and interactive access to multimedia information, powerful simulations, and a variety of people distributed all over the world, and make these resources available in the living rooms and on school desks everywhere.

However, what excites me most about this technology is not the pixels, megahertz, and gigabytes but what we as designers can do with this capability. The technology will not drive new designs. We can, of course, use these powerful computers as a delivery device to provide students with programmed instruction on the screen. But technology can enable new designs. We can choose to use this capability to explore new methods, to think about new learning experiences for students, and to find new ways to improve

education. The researchers in the articles I reviewed (Kozma, this issue) are engaged in this exploration; too often educational technology researchers are not. This is the tragedy and challenge confronting our field.

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