

**Research on Educational Technology:
Challenges to Implementation and Impact of Scientifically Based Research**

Lynne Schrum

Kelly f. Glassett

The University of Utah

Paper presented at the American Educational Research Association Annual Meeting, April 2006,
San Francisco

Research on Educational Technology:
Challenges to Implementation and Impact of Scientifically Based Research

Lynne Schrum and Kelly f Glassett

Introduction

Currently the research on educational technology exists in an environment that demands accountability and evidence based performance. In the area of educational technology, hardware and software have been in our schools in substantial concentration for almost two decades, and considering the financial investment required to put them into schools, it is important to base its implementation and use on demonstrated best practices. However, the body of usable research currently available is scant and scattered (Cradler, 2003). To date there have been few documented systemic increases in student achievement and learning that are directly attributable to technological innovations. In some ways the expectations have been extremely high due to hype, hope, and massive continuing costs incurred in providing a low computer-to-student ratio and connectivity to the Internet. The potential for educational technology to revolutionize education has been described over and over, and yet its promise has not been delivered (Conlon & Simpson, 2003; Cuban, 2001; Sandholtz, 2001).

Two forces are currently challenging traditional research in the field of educational technology: nationally, this research has been examined closely in an effort to determine if the expenditures on hardware and software have been worth the costs, and simultaneously, certain types of research have become the “coin of the realm.” Our current research was intended to identify the goals, challenges, and implementation of thoughtful educational technology research in the current climate, and to respond to a call for a proactive research agenda (Bull, Knezek,

Roblyer, Schrum, & Thompson, 2005). We gathered data from researchers in this field and sought to understand their response to the current demand for scientifically based studies. Additionally, this research sought to begin a dialogue among researchers with the goal of identifying a proactive research agenda.

Theoretical Lens

It is important to begin with a theoretical lens through which to think about implementation of the integration of technology. Fullan (2001) guided our conception about the challenges to changing educational practice. His notion of a complex, non-linear, and difficult process included three stages: initiation or adoption, implementation, and continuation or institutionalization. We recognize the culture of most schools, in which individual teachers are typically free to choose from a wide range of teaching practices, unless a systemic effort is underway. Additionally, Fullan suggested that teachers as learners require time to gain knowledge and then weave that knowledge into what they know and do in their instructional lives. Studying this process requires researchers who understand the complexity of this process and also recognize the need for multiple forms of data and data collection tools. The improvement in research in this area needs to attend to the features of the context within which innovations are implemented. This translates into examining multiple learning context measures for schools, teachers, and students using multiple methods. Given the complexity of these contexts (Roblyer, 2005; Surry & Ely, 2003), multiple forms of data analysis can be extremely helpful to researchers and policymakers because they convey the overall character of context effects within the area of study (Pearl, 2000). We argue that mixed methods research takes a more nuanced view of quantitative and qualitative analytics. From this stance, research can

examine multiple indicators from theory-influenced designs, and draw out data that inform theories of teaching, learning, and schooling.

Current status of U.S. educational research

Educational research in general has had an inauspicious history and has routinely been challenged as being driven by multiple masters and not providing strong evidence for the “one best way” of answering complex questions (Lagemann, 2000). Recently the calls for more specific and useful educational research have grown in frequency. At the same time, the U.S. Department of Education challenged all educational researchers to consider carefully what constitutes scientifically based research (SBR). The No Child Left Behind Act of 2001 specifically requires that SBR use empirical methods, rigorous data analyses, and measurements or observational methods to obtain reliable and valid knowledge. Research must be replicable and lead to findings that can be generalized and are accepted by independent sources. Even more specifically, the National Research Council (NRC) convened the Committee on Scientific Principles for Education Research; its goal was to study the nature of scientific inquiry in education (Shavelson & Towne, 2002). Although the call has been explained in a variety of ways (Shavelson, Phillips, Towne, & Feuer, 2003), many researchers have argued with the perceived unilateral view that is now the standard used to distribute funds. It is worth asking, how does this relate to our interest in and commitment to the investigation of the use of technology for teaching and learning?

Challenges to Implementation

The research into the uses and challenges to integrating technology in K-12 classrooms and curriculum has been extensive and yet it appears researchers continue to ask the same questions, struggle with conceptualizing appropriate research models, and report findings similar to those from other studies (Pollard, 2004-05). In 2003, Roblyer and Knezek (2003) outlined the topics and issues as they relate to theory on which “new research should focus”(p. 60) and Strudler (2003) reiterated the authors’ statements surrounding theory and research in technology in education, yet it seems little has changed since this exchange. In a meta-analysis of over 600 studies on ICT in education, Lagrange, Artigue, Laborde and Trouche (2001) concluded, “Research struggles to tackle the complexity of the integration of the evolving technologies” (p. 122). The What Works Clearinghouse (US Department of Education, 2006) identified one study in the area of student achievement and technology that meets its standards for Scientifically Based Research (SBR). Reeves (2000) summarized a review of educational technology research by stating,

At the risk of sounding yet another call for reform that may never come, three significant problems with IT research are highlighted below. First, major misunderstandings exist among instructional technologists about the differences between basic and applied research. Second, the quality of published research in the field of instructional technology is generally poor (although no poorer than educational research in general). Third, syntheses of instructional technology research, such as literature reviews and meta-analyses, provide practitioners with insufficient or confusing guidance. (p. 1)

This ongoing challenge in conceptualizing research questions has consistently plagued the field. In light of the struggle in identifying research in our field, and the current climate for educational research in general, we began this study with the following questions:

- What perspectives do educational technology researchers report regarding the Federal efforts toward scientifically based research?
- What do researchers report as the impact from these Federal efforts on their practice, including writing grants, reviewing research articles, etc?
- What recommendations do researchers have for articulating a proactive research agenda in this field?

Methods

In an effort to ascertain how the new climate of research is affecting the body of educational technology research, we sought to gather data from educational technology researchers. We conducted a pilot survey with members of the Special Interest Group of Teacher Educators (SIG/TE) of the International Society for Technology in Education (ISTE) and the Special Interest Group, Technology as an Agent of Change for Teaching and Learning (TACTL) of the American Educational Research Association (AERA). The pilot study resulted in 57 responses and provided a glimpse into educational researchers' perspectives on the impact of SBR (Schrum & Glassett, 2006). These individuals teach a wide variety of courses and most of them (89.1%) indicated they were aware of the U.S. Dept of Education's call for SBR in education. Most of the respondents (86.1%) indicated that they have followed the conversation in journals, Requests for Proposals, and educational media regarding the new directions of research. Respondents were asked specifically how the efforts for SBR have affected their own

research and in general, most of the respondents said that their research has been affected by the call for SBR. They reported that they consider the national efforts in their design of research, and that they are partnering with those who do quantitative research, and making sure they include mixed methods in grant proposals, and are adding surveys to other instruments. Of those who did not feel affected by the new requirements, some were already doing SBR, others avoided it, and still others said that they are making their doctoral students aware of the issues.

When asked about their own research agenda, a broad range of topics was offered, including looking at technology use in individual classrooms, large-scale investigations on programs, projects, hardware or software, and implementation of specific applications. When invited to describe a proactive research agenda for the field, many respondents took time to provide their thoughts on what such an agenda might include. Not surprisingly, many areas of agreement emerged. Overall, these researchers suggested the following major topics:

- Increase the studies on impact of technology on teaching, learning, student outcomes, instruction and pedagogy;
- Investigate the role of teacher beliefs, effective teachers; school culture/climate; collaboration; and low-end users;
- Examine technology issues (best software; upgraded hardware; online learning; nanotechnology)
- Improvement of researchers' skills
- Explore the nature of administrators, leaders, and budgets; and
- The role of technology in differentiated instruction and content knowledge

In addition to the similar responses, contradictions did emerge. Some felt we needed to include more theory in our research, specifically in cognition, and others felt we needed less

theory. Some researchers wanted to drop “satisfaction” studies, and others wanted to know more about student and teacher perceptions and motivations. The results of this pilot led to a need for further investigation of a larger group of researchers.

Participants. This study gathered similar data from four other AERA special interest groups of researchers in the area of educational technology (Education and the World Wide Web, Instructional Technology, Advanced Technologies for Learning, and Computer Applications in Education). These four groups represent researchers who are involved in some aspect of investigating educational technology. The invitation was sent to the SIGs asking for information on their awareness/reaction to the call for Scientifically Based Evidence in educational research, the impact on their research practice, and the impact if any on the ways in which they review journal articles or other academic information through a web based survey. Individuals completing the survey were also invited to participate in individual phone interviews.

Analysis. These data were examined using descriptive statistics, and the qualitative answers were open coded and examined for emergent themes across the groups (Merriam, 1998; Miles & Huberman, 1994). Individual interview transcripts were also coded and examined for emergent themes. Next the data were disaggregated by the group to which the respondents belong to determine if differences exist based on the affiliation of the researcher.

Results

A total of 59 individuals completed the survey. Respondents were asked to identify which AERA Special Interest Groups they belonged to (multiple responses were allowed; more than 100% total) and the results can be seen in Table 1. Ninety-one percent of these individuals teach at universities or colleges.

Table 1: SIG membership and responses

AERA SIG	Percent of Total	Responses
Education and the World Wide Web	35.7	20
Instructional Technology	51.8	29
Advanced Technologies for Learning	48.2	27
Computer Applications in Education	26.8	15

As expected, an overwhelming number of respondents (35) described at least some of their duties in the area of introductory or advanced educational technology classes. Three responded that they taught instructional design courses. Two respondents were not academics but did not explain their professions further. In addition, eight individuals reported their duties to be in the general area of teacher preparation, and a small number stated that they taught in educational administration, educational psychology, or a variety of content areas (social studies, literacy, educational research, special education, music, business).

The results demonstrated that these educators are very aware of the current efforts by the Department of Education in its call for SBR (90%) and 78% have followed the dialogue and conversations in journals regarding this issue. Seventy-four percent of the respondents indicated that SBR has effected how they get funding for research. Most of those responding that they have modified their plans for seeking funding explained that they now employ more quasi-experimental designs, include components of quantitative data points, or collaborate with colleagues who have more expertise in these areas.

The survey asked about the impact of SBR on respondents' view of literature. Sixty-two percent reported that the call for SBR has not influenced how they analyze literature and thirty-

eight percent indicated that it has effected how they view literature. This question produced interesting responses from participants. Sixty-two percent reported that the federal call for SBR has not affected the way they critically review or analyze literature. Of those who provided further explanation, most said that they already had been reading and analyzing literature critically all along. Of the 38 percent who reported a change in their reading of literature, some provided information about how this has affected them. They are more alert to effect size, control issues, and read more critically.

The respondents also provided some further insight into their consideration of literature and the larger issues around scientifically based research. For example, one respondent reported that this new push from the federal government has “underscored the need to demonstrate that all research is political.” This individual has student read research and write a press release from different stakeholders’ perspectives to demonstrate how easily results can be reported to further someone’s agenda. Another individual stated that it was an insult to all previous research to now declare that we needed scientific research. One person said that he/she observed an effort to “put new clothing on the outside” of research to represent it as fitting the new model required. And finally, one person declared that sometimes it appears that research methods have been chosen solely to satisfy this new requirement.

Tell us how this direction has impacted your research agenda. Seventy-two percent of the respondents indicated that the efforts toward SBR affected how they do research. The responses to this question were extremely informative. A strong minority of the respondents said that this has not had any influence at all. Those who expanded on this answer stated that they were already doing the things that were expected in the SBR model. Of those who declared that the

SBR requirements have made an impact, the responses were variable and individual; however, some themes emerged.

Many individuals responded that they now spend more time considering experimental or quasi-experimental designs. Others reported that they now always include quantitative measures or mixed methods in their designs and spend more effort in finding “documentable outcomes.” Those who classify themselves as primarily qualitative researcher try to partner with others who can compliment their work with quantitative aspects of the investigations. They feel it is now essential to do this, or as one put it, they are doing these “out of necessity.” Some said that they are much more careful about their own research and they try to find ways to answer areas of weakness by “showing relative advantage, showing how technological methods benefit learners and how to help technology become infused in all aspects of teacher education program.” A few respondents mentioned expanding the numbers of participants in their studies or including surveys in their design. More than one individual made a comment similar to this one, “The designs we are forced to adapt are often contrived.”

A sub-text ran through some of the comments. This refers to a concern for the participants, and the worry that randomization may not be appropriate for every research question. One person stated, “I have ethical concerns about allowing some students to have access to technology and some not to have access in order to do scientifically based research.” This concern is worthy of further discussion among our learning community.

If you were to design a proactive research agenda for educational technology, what topics and questions would you suggest? The responses provided a wide variety of topics clustered around significant themes. Many individuals suggested that a research agenda must recognize that different questions require different methods and that our research community requires a

“constantly updated taxonomy of what the most pressing research questions are...” The most commonly mentioned topics regarded student issues with technology (perceptions, assessment, learning outcomes, achievement, improving instruction) and educator issues (beliefs, moving from skills to integration, school culture and climate, technology in content areas, educational environments). These responses are similar to those reported in an editorial (Schrum, Thompson, Sprague, Maddux, McAnear, Bell, & Bull, 2005) based on discussions at the 2005 National Technology Leadership Symposium. In a discussion of a research agenda, participants identified a need for research on teacher beliefs about technology, teacher practice with technology, and student learning outcomes.

In addition, many respondents mentioned topics that are related to education more broadly. These include the impact of technology on second language learners, assistive technologies, inequity of access, motivation and self-directed learning, and online teaching/learning. A few responses mentioned looking at handhelds and gaming, the relationship between teaching style and use of technology, and the impact of constructivist projects on standardized tests. It is clear that a research agenda is still driven by the interests, experiences, and goals of any one individual researcher, and yet many areas of overlap do exist. One person’s comment may summarize thinking by many, “Delve much more deeply into discovering effective ways in which ET can help diverse sets of teachers and learners improve their achievement and motivational levels in a variety of discipline, then describe and catalog those strategies so that they can be disseminated, refined, and shared.”

In order to confirm or disconfirm survey data, we also conducted interviews with three-journal editors in the area of educational technology. All of the editors expressed a concern regarding the ethical nature of SBR and the use of control groups in real school settings. The

interviewees also expressed the idea that policymakers' view of SBR is a limited view of what research is, and that they need to realize that the social sciences are not the same as medical or hard science paradigms. For example, one said,

I think there are concerns of ethics surrounding SBR. I am concerned that we tell one group of parents that something works and then we turn around and tell another group of parents that it doesn't work or we don't tell them at all. This seems to be unethical. How do you have control groups in schools and still maintain ethics?

Furthermore, all of the editors spoke about the “messy nature” of this construct and the idea that we need to understand how the different variables in this construct interact with one another. They advanced the notion that statistical data alone cannot provide enough information for sociological understanding. They explained that statistical data have to be supplemented with qualitative data that informs the cultural milieu of classrooms and schools. Another editor commented,

Yes we do need more research in this environment; we need to understand kids learning and technology. How does it help what parts are working and what is not working? This is a messy context with a lot of variables, but at the same time we need to look at the big picture and it is very difficult to do that.

Discussion

Currently educational researchers who study the impact of technology have pressure to demonstrate results from using the technology and at the same time they are struggling with the challenges of the Federal requirements for Scientifically Based Research and evidence based claims. If we situate this conundrum in the context of the K-12 school pressures of high-stakes testing, NCLB, and limited financial resources, it is evident that a carefully organized research conversation may prove helpful to all of the stakeholders.

The respondents to this research study clearly have paid attention to the national dialogue and a sizable minority of these researchers is modifying the ways in which they read and analyze the literature, creating new ways to design their studies, and also changing the ways they apply for external funding. The stress placed on meeting a “gold standard” of research design, to the exclusion of other models (even when other models may be far more appropriate for the research questions) has had an impact on the ways in which researchers, at least in the study of educational technology, conceptualize and implement their work. This has implications for all our students, teachers in our schools, and future academics.

The nature of what it means to become an educational technology researcher is an area worthy of further research. If this next group of researchers is going to be prepared to identify significant research questions, and simultaneously take a stand for a balanced approach to investigating the questions of value, then it is important for these individuals to have mentoring and discussion throughout their education and initial academic experiences.

With specific guidance and inclusion in the development of the research agenda, future researchers will be prepared to meet the challenges that will face them. By helping them create human networks, prepare presentations and publications, and guide them in developing

grantsmanship skills, particularly for institutions without established research centers, we as a community can help prepare them as future researchers. Future researchers need to be able to examine the radical possibilities made more likely by new communications and computing technologies permeating society at accelerating rates. The growing global market of educational services and the possible reconfiguration of institutions devoted to addressing the needs of that market have just begun to receive attention from scholars. Studying such fundamental changes presents special challenges to scholars who must begin to develop new data sources and develop new theoretical perspectives that guide their inquiry.

Conclusion

In a review of educational technology policy over the past 20 years, Culp, Honey, and Mandinach (2005) concluded,

However, threaded among twenty years of research and policy work on technology's role in education is a conceptual framework for technology's use in education that offers substantial guidance for striking a balance between the demands of improving practice over time and pressing public concerns such as accountability and equity, between the cycle of change in technology and the cycle of change in schools, between the skills of tomorrow and the skills of today. (p. 24)

The complexity and challenges of our educational technology community are well documented. This research evolved from conversations and editorials throughout our research community. It sought to explore the impact of Scientifically Based Research (SBR) on the

research practice by individuals who are members of organizations devoted to the study of educational technology. Through pilot and follow-up surveys and interviews, data were gathered that make it clear these individuals are aware of the efforts toward SBR. The explanations given support the idea that those individuals who routinely used SBR have not changed the ways in which they analyze or conduct their work but that those who have used more mixed or qualitative methods have begun to modify and expand their efforts.

It would be interesting to determine if these data are similar to those found in other areas of educational research. It would also be relevant to determine the impact more directly on new members of the academy and for those doctoral students who aspire to that career. Our community would benefit from understanding how to assist those individuals. The editorial mentioned previously (Schrum et al, 2005) declared, “Our most pressing objective is to identify how we can assist the coming generations of young researchers in carrying out research that is needed, relevant, rigorous, and influential in the formulation of educational policies in schools” (np). Most importantly, our community would benefit from discovering the impact on our knowledge base from research that investigated appropriate uses of technology in our teaching and learning, and how that knowledge might change with the call for SBR.

References

- Bull, G., Knezek, G., Roblyer, M. D., Schrum, L., & Thompson, A. (2005). A proactive approach to a research agenda for educational technology. *Journal of Research on Technology in Education*, 37(3), 217-220.
- Conlon, T., & Simpson, M. (2003). Silicon Valley versus Silicon Glen: The impact of computers upon teaching and learning: A comparative study. *British Journal of Educational*

- Technology*, 34(2), 137-150.
- Cradler, J. (2003). Technology's impact on teaching and learning. *Learning and Leading with Technology*, 30(7), 54-57.
- Cuban, L. (2001). *Oversold and underused: Reforming schools through technology 1980-2000*. Cambridge, MA: Harvard University Press.
- Culp, K. M., Honey, M. & Mandinach, E. (2005). A retrospective on twenty Years of education technology policy. *Journal of Educational Computing Research*, 32(3), 279-307.
Retrieved January 14, 2006, from
<http://www.nationaletechplan.org/participate/20years.pdf>
- Fullan, M. (2001). *The new meaning of educational change* (3rd ed.). New York: Teachers College Press.
- Lagemann, E. (2000). *An elusive science: The troubling history of educational research*. Cambridge, MA: Harvard University Press.
- Lagrange, J. B., Artigue, M., Laborde, C., & Trouche, L. (2001). *A Meta-study on IC technologies in education: Towards a multidimensional framework to tackle their integration*. Paper presented at the Proceedings of the 25th Conference of the International Group for the Psychology of Mathematics Education. ERIC Document: ED 466 950.
- Merriam, S. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass Publishers.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis* (2nd ed.). Thousand Oaks, CA: Sage Publications.

- Pearl, J. (2000). *Causality: Models, Reasoning, and Inference*. Cambridge, UK: Cambridge University Press.
- Pollard, C., & Pollard, R. (2004/2005). Research priorities in educational technology: A Delphi study. *Journal of Research on Technology in Education*, 37(2), 145-160.
- Reeves, T. C. (2000). Enhancing the worth of instructional technology Research through “design experiments” and other development research strategies. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA, USA. Retrieved January 12, 2006 from <http://it.coe.uga.edu/~treeves/AERA2000Reeves.pdf>
- Roblyer, M. D. (2005). Educational technology research that makes a difference: Series introduction. *Contemporary Issues in Technology and Teacher Education*, 5(2). Retrieved 1/22/06 from <http://www.citejournal.org/vol5/iss2/seminal/article1.cfm>
- Roblyer, M. D., & Knezek, G. A. (2003). New millennium research for educational technology: A call for a national research agenda. *Journal of Research on Technology in Education*, 36(1), 60-71.
- Sandholtz, J. H. (2001). Learning to teach with technology: A comparison of teacher development programs. *Journal of Technology and Teacher Education*, 9(3), 349-374.
- Schrum, L. & Glassett, K. f. (2006). Technology integration in P-12 Schools: Challenges to implementation and impact of scientifically-based research. *Journal of Thought*, 41(1), 41-58.
- Schrum, L., Thompson, A., Sprague, D., Maddux, C., McAnear, A., Bell, L., & Bull, G. (2005). Advancing the field: Considering acceptable evidence in educational technology research. *Contemporary Issues in Technology and Teacher Education* [Online serial], 5(3/4). Available: <http://www.citejournal.org/vol5/iss3/editorial/article1.cfm>

- Shavelson, R. J., & Towne, L. (2002). *Scientific research in education*. Washington, DC: Committee on Scientific Principles for Education Research; The National Research Council.
- Shavelson, R. J., Phillips, D. C., Towne, L., & Feuer, M. J. (2003). On the science of education design studies. *Educational Researcher*, 32(1), 25-28.
- Strudler, N. (2003). Answering the call: A response to Roblyer and Knezek. *Journal of Research on Technology in Education*, 36(1), 72-76.
- Surry, D. & Ely, D. (2002). Adoption, diffusion, implementation, and institutionalization of instructional design and technology. In R. Reier & J. Dempsey (Eds), *Trends and Issues in Instructional Design and Technology* (pp. 183-193). Merrill Prentice Hall: Upper Saddle River, New Jersey.
- U. S. Department of Education, (2006). The What Works Clearinghouse. Washington, DC: Author. Retrieved January 21, 2006 from <http://www.whatworks.ed.gov/>.