Research Priorities in Educational Technology: A Delphi Study

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Abstract

This article reports on the findings of a Delphi study conducted to determine research needs in educational technology over the next five years. The Delphi panel consisted of 30 educational technology experts from throughout the United States who participated in a three-round consensus building process via the Internet. The results of this e-research study provide a framework of eight research priority areas and specific research topics for those engaged in educational technology. (Keywords: research priorities, learning, teachers, models, strategies.)

INTRODUCTION

Since the introduction of the computer into education in the 1970s, researchers have investigated its effects on students, teachers, and learning environments. Early studies were focused on demonstrating the impact of a particular technology or software on student achievement and student motivation. With increased access to computers and the Internet, researchers extended their efforts to investigate the role of technology in the educational setting, including its impact on teachers and the learning process. In the past decade, the study of the computer as an instructional delivery medium has been expanded to investigating technology as "a transformational tool and an integral part of the learning environment" (Fouts, 2000, p. 9).

A review of the literature discloses an abundance of educational technology research studies employing a variety of research methodologies in a variety of educational settings. In an effort to synthesize and analyze the results of these studies, a number of meta-analyses have been conducted. One of the more comprehensive meta-analytic studies (Kulik, 1994) summarized more than 97 of the computer-based instruction studies conducted in the 1980s, noting that students typically learn more and faster in courses involving computer-based instruction and have more positive attitudes. The results of his meta-analysis support the use of computers as a means to improve student achievement.

Schater (2001) analyzed a number of large-scale studies of educational technology and concluded that students in technology-rich environments experienced positive effects on achievement and a consistent improvement in self-concept. Moreover, his research supports the use of computer assisted instruction and collaborative networked technologies as a means to teach higher-order thinking.

Waxman, Connell, and Gray (2002), in a report commissioned by the U.S. Department of Education, presented a quantitative synthesis of recent research

on the effects of teaching and learning with technology. Using the statistical results of experimental and quasi-experimental published research, they concluded that there is a modest, positive effect of teaching and learning with technology on student outcomes. The authors noted a lack of quality, refereed quantitative studies in the area of educational technology and alluded to the serious problem of the lack of empirical evidence that certain programs or approaches utilizing technology are effective.

Although the results of many research studies and meta-analyses do show some positive results in the use of technology, policymakers want to see it decisively demonstrated that technology's value measures up to the cost. They are demanding evidence that their investments in educational technology have been worthwhile. The U.S. Department of Education has been rallying educators and researchers to marshal evidence that shows that students benefit from a high-tech environment. A recent paper commissioned by the U.S. Department of Education titled *A Retrospective on Twenty Years of Education Technology Policy* (Culp, Honey, & Mandinach, 2003) examined twenty years of key policy reports. Providing an overview and analysis of 28 reports, the authors concluded that, "The call for research on the impact of educational technology on schools and teaching and learning activities is a final constant theme found over the past twenty years of reports" (p. 15).

This mandate for research on the effects of technology on teaching and learning is clearly confirmed in the National Educational Technology Plan (U.S. Department of Education, 2000), "There is a pressing need for a high-quality, long-term national agenda for collecting, analyzing, and disseminating information on the use and effectiveness of technology in education" (p. 44). Moreover, one of the five goals outlined in the national plan is to provide "research and evaluation activities that will improve the next generation of technology applications for teaching and learning" (p. 4).

The question is, however, "what research will most benefit educators and where should research efforts be directed?" The call for research in educational technology is clearly evident, but there is a need for a framework for that research. This paper reports on the results of a national study that was conducted to provide guidance for the development of an educational technology research agenda.

The study, utilizing the Delphi technique, was undertaken to identify, categorize, and prioritize research needs that should be addressed in educational technology over the next five years. A Delphi panel of 30 educational technology experts throughout the United States was formed to generate, discuss, and rate research priorities in educational technology. This e-research (Anderson & Kanuka, 2003) study featured a three-round Delphi process completed via the Internet.

METHODOLOGY

The study employed the Delphi technique to obtain a consensus from educational technology experts about areas/issues that are most in need of research over the next five years. Initially developed by the RAND Corporation in the

early 1950s to predict future defense needs (Cope, 1981), the Delphi has now been implemented across discipline areas—and in education as early as 1971—as a means of obtaining opinions from persons without physically bringing them together (Cyphert & Gant, 1971).

Linstone and Turoff (1978) described the utility of the Delphi as a research technique particularly in the following situations:

1. The problem does not lend itself to precise analytical techniques but can benefit from subjective judgments on a collective basis.
2. The individuals who need to interact cannot be brought together in a face-to-face exchange because of time or cost constraints. Further, a conven tional conference tends to be dominated by particularly strong personalities or to give rise to an undesirable bandwagon effect. (p. 275)

A study examining the effectiveness of the Delphi in comparison to traditional discussion groups determined that the Delphi was the more effective because the "...anonymity and isolation of the participants facilitated a freedom from conformity pressures" (Van de Ven & Delbecq, 1974, p. 619). An additional perceived benefit of using the Delphi is the belief that the writing process enables participants to thoroughly deliberate and reflect upon all aspects of the problem. The result is participants' submission of precise, distinctive ideas.

While there has been considerable variance in administering the Delphi process, prescribed methodology requires that two cycles of questionnaires and feedback reports be used (Van de Ven & Delbecq, 1974). For this study, former Preparing Tomorrow's Teachers to Use Technology (PT^3) Grant Directors throughout the United States were e-mailed an invitation to participate in a three-round Delphi process involving two cycles of online questionnaires and feedback reports. Procedural steps were as follows:

Round 1: Participants were directed to the Delphi study Web site and asked to generate responses to the question, "What should the research priorities for educational technology over the next five years be?" Round 1 statements were arranged in categories according to research focus. Identified research statements and categories were then used to develop the Round 2 instrument.

Round 2: Participants were asked to rate the research statements and categories identified in Round 1 as to research need. In addition to rating each research statement, they ranked the major research categories in order of their perceived importance. Once returned, descriptive statistics for the group ratings were calculated: mean, median, and standard deviation.

Round 3: The ratings of research statements and rankings of major research categories by the group in Round 2 were compiled. Participants in Round 3 again ranked the major research categories as they did in Round 2, but this time descriptive information about how the group responded, as a whole, was provided. Participating experts were asked to review each item, consider the group response and then re-rate the items, taking the information into account.

The three-round Delphi process enabled the participants to generate their own opinions about necessary educational technology research areas, prioritize

research focus categories, and then to finalize their views based upon consideration of the entire group's opinions. This process, engendering the dynamics of effective group interactions, enabled researchers to gain a consensus from a panel of expert participants in diverse geographical locations about educational technology research priorities for the twenty-first century.

Delphi Panel Experts

The educational technology experts invited to participate in this Delphi study were individuals who had served as grant directors for a Preparing Tomorrow's Teachers to Use Technology (PT^3) grant. The PT^3 grant program (U.S. Department of Education, 2004) was created by Congress in response to the urgent call for teacher quality improvement and the need to reform teaching and learning in education. Since 1999, PT^3 has awarded more than 400 grants to innovative programs focusing on technology-infused learning in the K–16 environment, with formal and informal evaluation of grant interventions as integral elements. Although specific program components differed, each of the PT^3 grant awardees worked to transform education so that technology became integrated throughout the teaching and learning process. PT^3 grant awardees were required to provide a research basis for all grant activities, develop strong grant evaluation components, and use sound research methodology in examining the effects of technology interventions. Thus, PT^3 grantees were viewed as the most appropriate choices for participating on the Delphi panel based on their proactive involvement in promoting technology-infused learning in the K–16 environment and in examining the effects of those efforts.

As the Delphi process is a time-consuming one, potential expert participants were contacted in advance to determine if they were willing to commit to all three rounds of the research study. Sixty-three grant directors from the 1999 PT^3 grant program were contacted by e-mail and asked to particpate or to recommend someone from their grant (e.g., the grant evaluator) who was actively engaged in the grant technology research activities to take part in the study. Thirty-two educational technology experts initially agreed to participate, but only 30 were able to complete all three rounds of the Delphi process. A review of Delphi studies reveals that Delphi panels are usually comprised of 10 to 20 members and that "few new ideas are generated within a homogeneous group once the size exceeds 30 well-chosen particpants" (Delbecq,Van de Ven, & Gustafson, 1975, p. 89).

Table 1 provides the demographic characteristics of the 30 Delphi expert participants, who were primarily (90%) comprised of university professors and administrators. The 19 males (63%) and 11 females (37%) were experienced technology users, with 26 participants (87%) reporting more than 10 years of technology experience.

FINDINGS

The results of the three-round Delphi study reflect the consensus of opinions from 30 professionals in educational technology, all individuals who had worked as grant directors or grant evaluators for PT^3 grants. The Round 1 ques-

Table 1: Demographic Information of Educational Technology Experts Completing the Delphi Study

Demographic Item	N	%
Gender		
Male	19	63
Female	11	37
Education		
PhD	19	63
EdD	8	27
DPA	1	3
Masters	2	7
Current Position Held		
Professor	16	53
Administrator	9	30
Professor/Administrator	5	17
Years of Technology Experience		
5–9 years	4	13
10–15 years	8	27
16–20 years	13	43
Over 20 years	5	17
Institutional Affiliation		
University	27	90
State Department	2	7
Business	1	3
Geographical Location		
Eastern U.S.	11	40
Central U.S.	9	27
Western U.S.	10	33

tionnaire asked Delphi panel members to respond to the question, "What should be the research priorities for educational technology over the next five years?" In Round 1, expert participants generated 167 responses as to the research needs in educational technology over the next five years. These responses were reviewed by the researchers and consolidated so as to eliminate duplication. Common research theme areas with similar responses were compiled with as much of the respondent's original wording as possible retained. In total, 84 statements were compiled and then categorized under eight research priority theme areas: Assessment, External Influences, Current Issues, Learning, Models/Strategies, Schools, Teachers, and Web-Based Environments.

For Round 2, panel members were asked to rate the 84 statements on a Likert-type scale as to the degree of need (1 = No Need; 2 = Low Need; 3 = Medium Need; 4 = High Need; 5 = Very High Need) for research that each statement represents. Additionally, panel members were asked to prioritize the eight research areas and encouraged to comment on any of the research statements and/or areas. This was their first exposure to the research statements and areas generated by the panel, and they were informed that they would have another

opportunity to assign ratings in Round 3. This round allowed them to assign their initial perception of the need for the research knowing full well that they would finalize their ratings based on their perceptions and the panel's ratings in the next round. In this way, a group consensus on research priorities could be reached.

The Round 3 questionnaire featured the panel ratings for the 84 statements and eight research areas listing the mean, median, mode, and standard deviation. For this round, panel members were asked to review the research priorities, consider the group response and then re-rate the items, taking the information into account. The eight priority areas were also reviewed and participants re-ranked the areas from 1 to 8, with 1 being the top priority for research in educational technology.

Table 2 presents the Delphi panel's ranking of the research priority areas for educational technology over the next five years. Research in all aspects of learning and the effects of technology on the learning process was assigned the top priority, with research focused on teacher use of technology and teacher training as the second priority.

Table 2: Ranking of Research Priority Areas—Round 3 Delphi Responses

Rank	Category	Mean	Mode	N	%
1	Learning	1.32	1	22	73
2	Teachers	2.68	2	11	37
3	Models/Strategies	3.63	3	10	33
4	Assessment	3.89	3	10	33
5	Current Issues	5.21	5	11	37
6	Schools	5.57	6	13	43
7	Web-Based Environments	6.21	7	11	37
8	External Influences	7.47	8	27	90

The rest of this paper will discuss the research priority categories and the specific research statements within each priority area. Table 3 lists the 12 research statements included in the learning category with the Round 3 descriptive statistical summary.

Learning

Although the need to investigate the impact of technology on student achievement has been a common focus of technology research, the Delphi panel members still considered it a high priority for the next five years. Panel members commented on the establishment of federal, state, and local standards and accountability issues as additional reasons why it is so important to examine student achievement.

An examination of the mean ratings of the 12 research statements generated discloses a wide range of perceived need, with the panel members emphasizing broader, more comprehensive research on learning and student achievement (mean = 4.47) and less emphasis on investigations to determine the difference made by employing specific technologies (mean = 2.57). They advocated research examining how people learn using technology, unlike many past research

studies that have focused on specific technologies and their impact on learning a particular set of skills or content (Honey, Culp, & Carrigg, 2000). The Delphi panel recommended that research efforts be directed toward the role of technology in helping students to become better problem solvers and to accomplish learning tasks. Coupled with this examination was the need to design effective technology-enhanced learning environments to determine how technology contributes to student learning.

Panel members cited the need to conduct research that examines the impact of technology in relation to learning principles, brain research, and multi-modal learning. They discussed the need to develop an understanding of how people learn using technology and the impact of technology on the various domains of learning (cognitive, affective, and psychomotor). The emphasis was on "learning" and not on scores on achievement tests.

Table 3: Learning Research Category—Round 3 Delphi Responses

Research Need	Mean	SD	Mdn
Investigate the impact of technology on student achievement	4.47	.69	5
Develop and use learning principles to design technology-enhanced learning environments	4.10	.71	4
Examine the role of multi-modal learning to provide "just in time" and only "just as needed" solutions to training and informational needs	3.85	1.08	4
Link knowledge about teaching and learning with appropriate technologies	3.95	.60	4
Determine the efficacy of learning content using technology versus more traditional methods	3.45	1.09	4
Examine methods to learn technology contextually	3.40	.99	3
Determine if the level of technology use relates to the engagement of activities in the learning process	3.30	.57	3
Determine the impact of technology on various domains (cognitive, affective, psychomotor)	3.25	.71	3
Identify a taxonomy that best represents the issues and understandings of learner centeredness and deeper learning	3.25	.78	3
Examine methods to make students better at solving problems and accomplishing tasks using ICT (Information and Communication Technology)	3.25	.98	3
Examine how the brain learns and use brain science-based understanding of how to make effective use of ICT to help improve learning	3.15	.93	3
Investigate the cognitive paths of learners in interactive courses	3.10	.96	3
Determine which technologies are making a difference	2.57	1.3	2

Note. Participants were asked to rate each research statement on the basis of need using a 5-point Likert-type scale (1 = No Need and 5 = Very High Need).

Teachers

Research designed to develop models for preparing inservice and preservice teachers to be more effective users of technology was seen as a high priority area. Most of the panel members were directly involved in teacher training and perceived a need for research-based models for teacher training and professional development activities. Table 4 lists the eight recommendations generated by the group.

Table 4: Teachers Research Category - Round 3 Delphi Responses

Research Need	Mean	SD	Mdn
Develop models for preparing inservice and preservice teachers to be more effective users of technology	4.05	.68	4
Examine approaches that apply technologies to individualize teacher professional development based on real problems and opportunities in the teacher's classroom	4.0	.72	4
Examine technology barriers to assist inservice and preservice teachers when integrating educational technologies into the daily teaching and learning environment	3.85	.81	4
Examine the nature and extent of ICT (Information and Communication Technology) in preservice teacher education to produce teachers who effectively integrate technology (instruction and assessment) as soon as they get on the job	3.6	.82	3.5
Examine effective technology professional development practices in K–12 schools	3.45	.83	3
Examine teaching styles in relation to the use of technology	3.35	.75	3
Determine barriers to using technology in the classroom (hardware availability, time, etc.)	3.15	.93	3
Determine the influence of handhelds (Palms) on critical thinking and teacher behavior	2.95	.88	3

Note. Participants were asked to rate each research statement on the basis of need using a 5-point Likert-type scale (1 = No Need and 5 = Very High Need).

The Delphi panel experts not only expressed a need to develop models for preparing technology-proficient preservice teachers, but wanted to examine the nature and extent of ICT (Information and Communication Technology) in preservice teacher programs to produce teachers who effectively integrate technology as soon as they begin their teaching duties.

Acknowledging that there are barriers to integrating technology, the panel recommended research to examine those barriers in order to develop ways to assist inservice and preservice teachers. As one panel member wrote, "Teachers are the key to technology integration. If we want them to integrate technology, they need to help in overcoming the many challenges associated with using technology."

Models/Strategies

The focus of the recommendations in this category was to examine ways to improve teaching/learning through the use of technology-based instructional models and strategies. The Delphi panel generated 15 research statements that were included in a category titled Models/Strategies. Although the members of the Delphi panel generated more research statements within this category than any other in the study, it should be noted that no mean rating for individual research statements was over 4.0, as was evidenced in some of the other research categories. The fact that the panel members were, on the whole, heavily involved in teacher training could account for the preponderance of suggested research activities. Table 5 lists the 15 statements and descriptive statistical summary for each statement. This research priority area featured recommendations from the educational technology experts to examine the use of technology to develop instructional models and strate-

Table 5: Models/Strategies Research Category—Round 3 Delphi Responses

Research Need	Mean	SD	Mdn
Examine and develop models for integrating technology into K–12 instruction	3.95	.82	4
Examine the use of technology to support distributed learning and project-based learning	3.85	.87	4
Determine "best practices" scenarios for teaching with technology	3.8	1.00	4
Examine the use of technology enhanced instructional strategies to benefit specific groups of students	3.6	.59	4
Investigate ways to use technology to extend the learning experience beyond the traditional classroom	3.6	.88	4
Develop effective educational simulations	3.4	.94	3.5
Determine effective use of tool software to support the teaching and learning process	3.3	.73	3
Create interoperable technology applications	3.2	.95	3
Determine the impact of digital engagement practices (i.e., digital storytelling and ThinkQuest) on K–12 student achievement	3.3	.80	3
Develop more effective software to promote student learning	3.15	.87	3
Determine areas in which Highly Interactive Computer-Assisted Learning is more effective than traditional teaching	3.1	1.02	3
Restructure "tutoring" software to learn from the student	3.05	1.05	3
Examine the role of "expert systems" to enhance learning	2.95	.82	3
Develop intelligent tutoring systems for appropriate higher ed courses and programs	2.95	1.05	3
Determine effective use of peripheral devices for supporting teaching/learning	2.75	.71	3

Note. Participants were asked to rate each research statement on the basis of need using a 5-point Likert-type scale (1 = No Need and 5 = Very High Need).

gies to support learning. Moreover, recommendations to determine the best use of technology to support specific learning models (distributed and project based learning) were cited by the experts.

Although the investigation of specific technologies was given less priority, Delphi panel members did suggest research in determining the effective use of tool software and peripheral devices. Examining the effects of digital engagement practices (i.e., digital storytelling and Thinkquest), tutoring software/systems, and expert systems were also suggested as research topics.

Assessment

The need to determine methods and criteria for evaluating the effectiveness of technology enhanced instruction, including assessment that is multifaceted, were priority topics included in the assessment category. Table 6 presents the 10 research statements generated by the Delphi participants, with mean ratings from 2.95 to 4.35.

Table 6: Assessment Research Category - Round 3 Delphi Responses

Research Need	Mean	SD	Mdn
Determine methods and criteria for evaluating the effectiveness of technology-enhanced instruction	4.35	.74	4.5
Employ assessment that is multifaceted (not just focused on high-stakes testing)	4.25	.71	4
Determine the effectiveness of using electronic teaching portfolios to assess performance in meeting the various standards	3.8	1.0	4
Create an infrastructure for using technology to support teaching rigorous content and formatively assess student learning with respect to this content	3.65	.98	4
Examine the use of technology to enhance alternative forms of assessment	3.6	.75	4
Determine performance outcomes of student use of technology tools in academic areas	3.3	.73	3
Develop appropriate (fair, valid, reliable, cost-effective) assessment of student use of ICT as an aid to solving problems and accomplishing tasks in all subject areas	3.2	.89	3
Examine the role of non-intrusive, real-time assessment of student learning in optimizing time-on-task and teacher efficacy	3.2	.89	.3
Validate assessments for determining technological knowledge, skills, and dispositions	2.95	.68	3
Examine the use of PDAs for assessment	2.95	.82	3

Note. Participants were asked to rate each research statement on the basis of need using a 5-point Likert-type scale (1 = No Need and 5 = Very High Need).

Current Issues

In this category, Delphi panel members recommended that research be concentrated primarily on digital divide issues, including ways to eliminate or lessen the effects of the digital divide. Other issues included changes resulting

from the use of technology, including the effects on social interaction and collaboration. The student use of computers outside of the school day was also suggested as an area in need of further research. The seven research statements are listed in Table 7 below.

Table 7: Current Issues Research Category—Round 3 Delphi Responses

Research Need	Mean	SD	Mdn
Develop strategies to eliminate or lessen the effect of the digital divide	3.95	.82	4
Examine digital equity issues relating to low SES, gender and ethnicity	3.65	.93	4
Examine the effect of technology on social interaction and collaboration	3.6	.68	3.5
Determine factors influencing the digital divide	3.4	1.04	3
Examine human-computer interactions (information retrieval, immersive environments, usability, etc.)	3.35	1.03	3
Determine the ability of technology to engage students in important activity outside of the normal school hours	3.2	.95	3
Determine the effects of educational technologies in a variety of "one-to-one" student/computer environments (home and school)	3.15	.87	3

Note. Participants were asked to rate each research statement on the basis of need using a 5-point Likert-type scale (1 = No Need and 5 = Very High Need).

Schools

The role of technology in fostering school improvement and ultimately student learning were emphasized in the Schools research area (see Table 8). Of highest priority was the need to investigate the role of technology in the change process, with Delphi panel experts citing the need to examine ways in which technology can facilitate educational transformation, assist in assessing student growth, and help in making effective data-driven decisions. The Delphi panel advocated research to determine the crucial role of technology in facilitating educational transformation and school reform.

Table 8: Schools Research Category—Round 3 Delphi Responses

Research Need	Mean	SD	Mdn
Investigate changes in classroom, teacher roles, and schools due to technology integration	4.2	.61	4
Investigate the effects of new models of schooling (using technology) to develop higher-order outcomes and critical attributes (i.e., creativity, problem solving, teamwork, etc.)	4.0	.74	4
Examine the role of technology in helping schools look at more than student performance in school improvement planning	3.5	.82	3
Examine the role of information technology in facilitating educational transformation	3.5	.82	3

Table 8 con't

Research Need	Mean	SD	Mdn
Examine the role of technology in broadening the definition of Annual Yearly Progress and building school "report cards" that reflect student growth	3.5	.88	3
Determine the effect of administrative data-driven instructional decisions on student/school/classes	3.5	.94	3
Determine the best uses of computer mediated communication among schools to encourage and support innovation/research	3.45	.83	3
Examine the role of change theory and models to foster changes in schools when integrating technology	3.4	.75	3
Determine the use and effectiveness of technology in rural schools	3.3	.97	3
Determine the impact of administrative support on technology implementation	3.25	.85	3
Examine the role of funding in the support and use of technology	2.95	.82	3

Note. Participants were asked to rate each research statement on the basis of need using a 5-point Likert-type scale (1 = No Need and 5 = Very High Need).

Web-Based Environments

Table 9 lists the Delphi panel recommendations for research to be conducted within Web-based environments. Of top priority is the need to investigate the online collaborative leaning process in an effort to develop collaborative tools to support that process. Research to determine effective online instructional models and the effects of online instruction on student learning were advocated as well.

Table 9: Web-Based Environments Research Category—Round 3 Delphi Responses

Research Need	Mean	SD	Mdn
Investigate the online collaborative learning process	3.95	.68	4
Examine the challenges faced in moving from teacher-centric transfer model of learning to the design of rich, Web-based learning-centered environments	3.85	.74	4
Develop collaborative tools to support collaborative processes	3.8	.89	4
Examine the role and structure of effective online mentoring	3.7	.86	4
Examine the integration of models of instruction into Web-based instructional strategies	3.65	.74	3.5
Develop models for online instruction	3.55	.68	4
Determine the effect of virtual classrooms on student learning	3.55	.99	4
Determine the impact of e-learning on educational programs	3.35	.58	3

Table 9 con't

Research Need	Mean	SD	Mdn
Determine the effects of connecting at-risk students with advocates who care about and communicate with the student electronically and not face-to-face	3.2	.61	3
Examine the role of video literacy to support the replacement of current text-based Internet communications	3.05	.82	3

Note. Participants were asked to rate each research statement on the basis of need using a 5-point Likert-type scale (1 = No Need and 5 = Very High Need).

External Influences

Although external influences were recognized as having an effect on the use of technology in the schools, there were few areas considered as priority for research. Table 10 lists the recommendations, which received mean ratings of 1.65 to 3.4, the lowest ratings of all the research categories.

Table 10: External Influences Research Category—Round 3 Delphi Responses

Research Need	Mean	SD	Mdn
Examine the impact of Federal and state policy on the use of technology for teaching and learning	3.4	1.09	4
Identify uses of the Internet to improve educational reform and **[QA: Are word/s missing here?]**	3.2	.89	3
Develop policies to facilitate compatibility and interoperability between state accountability systems practices	2.75	1.02	3
Determine the impact of top-down approaches, at the federal and state levels, that lead to appropriate use of ICT (Information and Communication Technology) in schools	2.7	.80	3
Define and determine support for technology literacy	1.65	.81	2

Note. Participants were asked to rate each research statement on the basis of need using a 5-point Likert-type scale (1 = No Need and 5 = Very High Need).

Highest Priority Research Activities

An examination of the statements included within each of the eight research priority categories reveals six specific research activities considered as the greatest priority. These six research statements, as listed in Table 11, received a mean of over 4.0, placing them in a very high-need rating.

SUMMARY

A review of educational technology literature over the past three decades reveals a proliferation of research articles and national reports detailing the effects of computer technology in the classroom. In the 1970s and '80s the majority of research efforts examined the effects of particular technologies or software on student learning (typically evidenced by student scores on a particular subject-

Table 11: Specific Research Statements of Highest Priority - Round 3 Delphi Responses

Research Need	Mean	SD	Mdn
Investigate the impact of technology on student achievement	4.47	.69	5
Determine methods and criteria for evaluating the effectiveness of technology enhanced instruction	4.35	.74	4.5
Employ assessment that is multifaceted	4.25	.71	4
Investigate changes in classroom, teacher roles, and schools due to technology integration	4.2	.61	4
Develop and use learning principles to design technology-enhanced learning environments	4.10	.71	4
Develop models for preparing inservice and preservice teachers to be more effective users of technology	4.05	.68	4

Note. Participants were asked to rate each research statement on the basis of need using a 5-point Likert-type scale (1 = No Need and 5 = Very High Need).

related test), student attitudes, and attendance (Honey, Culp, & Carrigg, 2000; Roblyer, 1988). The '90s brought about some changes: the focus began to shift from research on specific kinds of technology and their effects on student learning to a broader examination of the effects of technology on the analytical and creative abilities of students. Moreover, new graphic-rich interactive technologies have helped shape the direction of research efforts, with researchers investigating all facets of the online learning environment and the opportunities provided by the Internet for teaching and learning.

For the last 20 years, government-funded policy reports have repeatedly identified the need for research on the effect of educational technology on teaching, learning, and schools to substantiate increased technology funding. Recent reports (Culp et al., 2003) advocate the need to "establish a definition of conditions for effective use of technology; create new measures of progress and indicators of effective use; and design new approaches to assessment and more sensitive evaluation tools" (p. 16). These research priorities were identified by the Delphi panel members as well.

The *Teachers' Tools for the 21st Century* report (National Center for Education Statistics, 2000) espoused nine research questions to guide educational technology research efforts. Among the research focus areas were the need to determine types of technologies available in schools, changes to enable increased use of technology, fiscal expenditures on technology at all levels, and the benefit of technology in terms of costs. Although the Delphi panel members did not address these more monetary issues, they did echo the report's stated need for research in technology as it relates to learning, teacher training, assessment, and the effect of technology on schools and educational reform.

Specifically, the members of the Delphi panel advocated a research agenda that includes an examination of the following areas:

1. *Learning*—examine the relationship of technology and how people learn in cluding an investigation of the learning process, learner engagement, and contextual learning.
2. *Teachers*—develop models for preparing inservice and preservice teachers to be more effective users of technology.
3. *Models/Strategies*—develop technology-rich instructional models to sup port student learning in the classroom and in the online environment.
4. *Assessment*—develop appropriate methods and criteria for evaluating the effectiveness of technology-enhanced instruction, particularly for more complex learning tasks.
5. *Schools*—investigate changes in the classroom, teacher roles, and schools due to technology integration and determine how technology might best facilitate educational reform.
6. *Social Issues*—investigate factors influencing the digital divide and the ef fects of technology on social interaction and collaboration.

The need for empirical research determining the effects of technology on teaching and learning has been well recognized. The members of the Delphi panel in this national study not only supported this premise, but advocated that there be a "rigorous documentation" of the link between technology use and learning. Given the complex nature of technology, they agreed that there should be a complex and blended approach to research that seeks understanding about a broad range of factors. Moreover, the panel members recommended that educational technology research methodology include the use of longitudinal and mixed-methods research involving teachers and classrooms. The use of multiple methodologies and a triangulation of findings in educational research will provide the "rigorous documentation" advocated by panel members. Furthermore, the results of this study provide specific research priority areas and topics for those engaged in educational technology.

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