Integrating technology into learning: A summary view of promises and problems

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ABSTRACT
The articles published in this issue covered a wide spectrum of promises and problems related to integrating technology into learning. The three full papers addressed (1) technology integration to enhance social interactions, (2) influences of technology-enhancements on teaching practices and learning processes, and (3) technology as a tool to record and assess the processes of developing shared understanding and the resulting shared understanding. The short articles addressed promises and problems within the categories of technology integration, perception of technology integration, cultural considerations, systems and environments, evaluation and assessment, implementation, and individual differences. Several product and project reviews introduced and described technology-based products and technology integration efforts. The wide spectrum of literature on technology integration described promises such as effects on communication, learning, and understanding of these new resources and problems such as collaborative development, access, sustainability, effort, and money investments in such efforts. Thus these articles provided new insights that will inform the current rhetoric and practices of technology integration.

Key words
Technology integration, technology issues, technology opportunities

Introduction

The rhetoric related to the integrating technology into learning leaves few stones unturned. Scholars argue for and against definitions, terminology, values, and appropriateness of technology integration. Researchers and practitioners have suggested new methodologies for planning and designing technology interventions, new assessment and research strategies for investigating the effects of technology integration, and new learning archetypes that supposedly aid in designing more effective instruction that integrates technology resources. Many assume that integrating technology into learning has radically changed the way instruction and performance support systems should be designed, and the way we should teach, learn, and work. This debate continues to be fueled by a small number of the total number of development and research projects, mainly framed in K-12 or higher education. Many design and research projects not currently documented in the literature hold promise for identifying opportunities and challenges of technology integration in educating, training, and working. New technologies, however, are being rapidly introduced into learning environments before we learn how to make effective use of existing technologies. This issue of Educational Technology and Society put forth a call for manuscripts requesting authors to consider…

“Rather than jump from one technology fad to another or leap to conclusions that new technologies require new planning and design processes or radically different learning paradigms, it appears reasonable to consolidate what we know works best in which various learning and work environments and to identify known gaps in our knowledge and areas where new technologies simply do not fit well into existing frameworks.” (Spector, call for manuscript ET&S special issue)

This first, in the series of two special issues, has focused on identifying promises and problems related to integrating technology into learning. The collection of articles were included topics on:
- specific features of technology resources such as computer-mediated communications;
- issues and challenges of integrating technology in the classroom;
- instructional design, development and assessment of educational technology; and
- interactions that may exist between personality and cultural factors and collaboration in technology-enhanced learning and work settings.

Each paper in its own right provided a detailed account of promises and problems encountered during a specific technology integration project or investigation. Each group of papers, as defined by the series of headings in the
next section, provided a wider perspective of promises and problems within a specific domain, e.g., technology integration, perceptions of technology integration. The complete set of works in this issue in turn has provided a systemic view of the promises and problems of technology integration on learning.

A Summary

Computer-Supported Collaboration, Dimensions of Technology Integration and Assessing Technology-Mediated Interactions

The three full papers in part one of this special issue describe vastly different perspectives of integration of technology into learning. Kreijns, Kirschner and Jochems describe issues surrounding computer-supported collaborative learning (CSCL). They argue that in general, computer environments do not adequately address the social-psychological dimensions of social interactions, a key component of the learning process. They propose an intelligent CSCL environment based on a theoretical framework that embeds social affordances into the learning environment and increases the sociability of the learning system. Naidu, Cunnington and Jasen’s perspective of technology integration addresses another dimension of technology integration. They describe a research project that investigated how technology-enhanced teaching and learning resources influenced teaching practices and learning processes. They provide a description illustrating how their collection of technology integration practitioner stories and participant artifacts were archived and used to promote faculty development. Finally, Mulder, Swaak and Kessels describe a process for assessing shared understanding in technology-mediated interaction. They make a distinction between the process of reaching shared understanding and the resulting shared understanding and used these conceptual ideas to develop a coding scheme for analyzing technology-mediated interactions.

Each paper in its own right helped to develop a more complete picture of specific technology uses - technology as a social tool, technology as a source of influence in educational change and professional development, and technology as a repository of data for analysis of understanding, respectively. As a collection, these three papers provided a wider understanding of the breadth and depth of opportunities and issues related to integrating technology into learning. A picture began to emerge demonstrating that the promise of well designed technology interventions can support and encourage socialization, train and educate educators and learners, capture and store illustrative examples and data, and provide means to assess learning and working, simultaneously. Some problems were also identified, such as, benefits of using information and communication technologies do not always justify the cost, time and effort that work entails. Although the blending of learning and performance systems through strategic use of technology resources was not described in any one project, conceptual links can be made thus establishing a research agenda that expands the levels and dimensions of inquiry beyond current views of technology as a lever to radically change the way we teach, learn, and work.

The collection of short articles and reviews provided a more intimate view of additional pieces of this puzzle including technology integration, perceptions of technology in the school system, cultural considerations, systems and environment considerations, frameworks for assessment and evaluation, examples in practice, and individual differences. The introductory article provided an activity system perspective to make sense of these pieces and their relationships. We shall do so in a different way in the following sections.

Technology Integration

Three articles addressed issues of technology integration. Ehrlich’s study, based on the four elements of learner centered interactivity - learner-to-interface, learner-to-content, learner-to-learner, and learner-to-instructor - resulted in the description of foundational framework for redesigning existing courses into distance education formats, creating new distance education courses, and establishing new research areas for distance education. Gold, Swann and Chief described a courseware development project that resulted in the identification of conflicting pressures and constraints, ultimately affecting the development and usefulness of distance education technology resources. Suggestions included separating the medium of courseware development (the computer) from the delivery system (video) and using familiar and available software for development. In the third article, Novaczek and Gabriel described the difficulties encountered when moving learning resources onto an on-line platform. They noted that the cultural shift of the development teams and course teachers required consideration of pedagogical value, course migration management and consistency, and a prolonged and participatory process. Together these articles suggested that the complexities of technology integration required consideration of foundational instructional design frameworks, attributes of the educational and technological environment, and
stakeholder participation. Main challenges summarized in these articles included teaching culture transition, lack of technology resources to successfully conduct projects, and lack of student access to technology.

**Perceptions of Technology Integration**

The second series of short articles addressed differing perceptions of technology integration in school settings. Cope and Ward described the different perceptions that high school teachers had about learning technologies. These perceptions were linked to the successful, or unsuccessful integration of technology into teaching and learning environments. It was suggested that perceptions of technology are paramount to encourage successful technology enhancements in the classroom. Kincaid and Feldner described the perception of technology integration through the eyes of principals and mentors in a school system. They suggested that the impact of mentors on teacher preparedness to and continual involvement in technology integration efforts was related to mentor training and selection. Diericks-O’Brien and Sharratt investigated how expectations and beliefs of academic staff about technology impacted the design and integration of student learning experiences. They suggested a collaborative process was needed in order to encourage academics, educational advisors, and multimedia producers to work together to produce effective learning media that could be successfully integrated into the student learning experience.

This series of short articles illustrated the importance of considering educators’ perceptions of technology, support structures in the school setting, and the dynamics of collaborative technology resources development when integrating technology resources into educational systems. However, it was recommended that future research is needed to investigate how to connect perception of technology component and nature of impact, how to reach agreement among development team members and how to determine criteria for defining successful support structures.

**Cultural Considerations of Technology Integration**

Two of the short articles provided insights into the cultural considerations of technology integration. Hughes, Wickersham, Ryan-Jones, and Smith argued that current literature suggests initial face-to-face meetings expedited trust, familiarity, and willingness of learners to engage in distance education. One of the draws of distance education is that it is convenient to learners - for example, learners can participate in their own time, from their own location. Hughes et al., suggested that trust, familiarity, and willingness were not as easily developed at a distance, however, computer-mediated communications could be used to breakdown social barriers in distance education courses and foster social interactions from a distance. Slay, on the other hand, took a broader perspective of learning in technology enhanced environment. She argued for analyzing learning environments and gauging the impact of culture from the perspective of human activity systems when designing learning environments for multicultural settings. These perspectives added breadth to the aspects of technology integration, one from a focus of using technology to breakdown social and cultural barriers and the other from analyzing the use of technology to support multicultural settings.

**Systems and Environments**

Edmonds and Pusch, and Sagais both provided insights into technology integration systems and environments. Edmonds and Pusch described the features of a well-designed instructional knowledge management system and how it can be used to facilitate group collaborations. Sagias described a longitudinal project investigating the design and development of sophisticated and fully interactive distributed collaborative multimedia applications. Problems encountered were related to the amount of flexibility that can and should be designed into training. Together these articles suggested opportunities for using knowledge management systems and collaborative multimedia applications to enhance learning through technology integration. The challenge was to determine how best to use these systems and environments.

**Assessment and Evaluation**

Assessment and evaluation frameworks are often neglected in technology integration efforts. Learning outcomes are often assumed to be related to technology. Ewing and Miller identified central issues related to collaborative learning and described a scenario using these central issues to evaluate an e-learning case. Browne described the
attractiveness of automated tutorials and assessment. He suggested that intelligent tutoring systems have the ability to respond to the needs of individual learners, computer-based modeling packages can provide immediate feedback, and the Internet provides a means for managing tutorials and assessments. Assessment was thus considered from two perspectives, one of defining issues central to learning with technology and the other from using technology to facilitate feedback and management of teaching and assessing learners. However, problematic issues such as social-cultural and cognitive influences and learner control were rarely considered when designing automated assessment tools. These factors are still a challenge of integration technology into learning.

**Technology Integration Examples**

McKinnon and Geissinger described several astronomy-related web resources that can be used to motivate elementary and junior high school students through virtual hands-on experiences that help build scientific understanding. Rountree, Wong and Hannah described a case study investigating the effectiveness of virtual artifacts in teaching university students. They described how digital images could mediate focus and support development of visual literacy. Saunders and Quirke described the problems associated with integrating laptop technology into a Middle Eastern university. They discussed issues such as culture, gender, infrastructure and support, ultimately suggesting guidelines to help faculty cope with new workloads and learning paradigms. Bianchi examined the historical success of technology integration of the institute being studied. He suggested that the promise of learning gains were due to the institutes history of focusing on educational needs, designs that stimulate active involvement in learning, opportunities for engaging in the social aspects of learning, and maintaining a human touch when technology was integrated into learning. Each of these examples illuminated promises such as increases in motivation, skill and knowledge development, and access to information, and problems such as cultural considerations, infrastructure, and support, as technology was integrated into a learning environment.

**Individual Differences and Abilities**

The last series of two articles addressed individual differences and abilities related to technology. Luke argued that a significant portion of the population is often neglected from online learning environments. He provided an overview of an inclusion study and suggested principles that would address accessibility for all learners. Babaeva and Voiskounsky addressed individual abilities from the perspective of IT-giftedness. They described a dynamic approach where intelligence, social skills and personality traits of professional software engineers were analyzed. From this analysis they suggested how these traits might be used to develop IT-giftedness in children and adolescents.

**Product and Project Reviews**

This issue also contained a combination of three reviews of technology products and integration efforts. Alevizou compared digital versions of Encyclopedia Britannica and Microsoft Encarta in light of encyclopedia publishers’ drive to re-establish their position in the information age. Research recommendations were suggested to inform the use of comparison elements in terms of technology literacy and preferences of the ultimate users. Area provided a review of the Virtual Network for Adult People Education (RedVEDA) project. The project goals were to train teachers in the use new technologies and technology-enhanced curriculum materials. The project team fell short of goals to sustain implementation, however had success with the initial teachers. Important learnings included:

- providing technology support when technology is integrated into a school system;
- having a plan in-place to facilitate the process of adopting innovations;
- maintaining close communication and negotiation links with sponsoring agencies; and,
- developing an understanding of the patterns of community practices as they emerge during the process of technology integration.

Finally, Tiedemann commented on 15 delivery options and software applications for distance learning. A summary of developing versus buying decisions was provided as well as a discussion of development and delivery issues. Together these reviews provided guidance on the types of issues to consider when making product and implementation projects decisions.
Conclusions

Assumptions are made that integrating technology into learning radically changes the way we design instruction, teach, and learn. The body of literature is growing and represents only a fraction of development and research efforts currently underway. Technology is widely used in a variety of educational and performance support situations. Educators, researchers, and learners are forming opinions and practices based on their experiences.

Potential promises of technology integration included the use of technology: to collect examples of success and failures that can be re-purposed for professional development, build new skills and knowledge such as visual literacy, increase interactivity during learning, breakdown social barriers in multicultural environments, support just-in-time training, facilitate group collaborations, refine assessment and evaluation procedures, motivate and provide hands-on experiences in virtual realistic settings, and provide access to new sources of information. The problems of technology integration are also many. Practitioners need to consider the affordances of their specific environment including money, technology resources, and technology support structures. Developers need to figure out how to work effectively with the broad spectrum of experts needed to design technology resources and implement them effectively into learning environments. Those who support and use technology resources need to develop appropriate technology and teaching skills and enhance their perceptions of technology as a part of the teaching and learning environment, not the driver of teaching and learning. Considerations for individual differences and abilities need to be factored into technology-based products and implementation efforts. These experiences have informed what we know about the promises and problems of technology integration. The wide spectrum of literature on technology integration presented in this issue provided insights that will certainly inform the current rhetoric and practices of technology integration.

The second part of this special issue of Educational Technology and Society on “Integrating Technology into Learning and Working” will continue to share new perspectives of technology integration and begin to address issues technologies use to support of the school to work initiatives. The second part of this ongoing dialogue is more explicitly focused on technology in working environments, although we maintain our belief that one effect of new technologies is to erode the traditional distinction between learning and working (as reflected by including ‘working’ in parentheses in the title to part one). Part two will be structured in a similar way, with full papers, short papers grouped around critical aspects of the larger activity system framework presented in the introduction to part one, several review articles, and a second synthesizing paper that takes a look into a promising future with regard to integrating technology into learning and working.