Integrating Technology into Learning and Working: Promising Opportunities and Problematic Issues

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ABSTRACT
In this introductory article, a context for the special issue and a framework for the discussion in this issue are provided. A broad interpretation of terms is postulated, e.g., technology includes methods and techniques as well as tools and equipment; integration refers to a process of combining various distinguishable parts to create a complex whole; learning include individuals and group, changes in directly and indirectly observable aspects, in both intentional and incidental situations; and work involves an activity or related set of activities that require effort and are aimed at achieving one or more objectives. Finally, a framework based on an activity system is provided to group the articles in this part into several themes.

Keywords
Learning environments, Performance technology, Technology integration

Introduction
In this introductory article to the first part of the special issue on “Integrating Technology into Learning and Working,” we shall provide a context for the papers included in the first part of the special issue and create a framework for ongoing discussion about the issues we raised in the original call for papers. In October 2000, the editor of Education, Technology and Society (ETS) (Kinshuk) approached one of the co-editors of this special issue (Spector) about the possibility of editing a special issue on a topic of interest and relevance. The invitation was accepted and the following proposal was submitted and published in November 2000:

Special Issue Proposal for “Integrating Technology into Learning and Working”

Technology is now widely used in a variety of educational and performance support situations. New technologies are being introduced before we learn how to make effective use of existing technologies. 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. Some things appear clear. First, the distinction between learning environments and performance and decision support for work environments is less and less clear. Moreover, some new technologies (e.g., Personal Digital Assistants) do require new frameworks for planning and implementation. Finally, new technologies provide for new planning and design possibilities (e.g., collaborative design and development).

This special issue will focus on Integrating Technology into Learning and Working. Issues relevant to this topic include, but are not limited to the following: (1) the impact of new technologies on the design, development and delivery of educational and training materials; (2) the apparently disappearing distinction between learning and working; (3) new frameworks for planning and implementing learning and work support materials for new technology settings; and (4) interactions that may exist between personality and cultural factors and collaboration in learning and work settings.

The announcement of the special issue in ETS resulted in more than 150 proposals. Since many of the proposals were well within the topic area and represented reputable individuals and institutions, two things quickly became clear. First, there would most likely be too many quality papers for a single issue. Second, the task of editing the papers far exceeded the capacity of a single individual. The ETS editor was approached about the possibility of a special two-part issue and a co-editor. Happily, both of these items were quickly resolved.
Based on the original announcement and the papers received, we decided to focus the first part of the special issue on learning and the second part on working. Our intent was not to blindly accept the traditional distinction between learning and working. Indeed, the second part raised in the original proposal concerned the disappearing distinction between learning and working, and the title to this first part of the special issue includes a reference to working. Nevertheless, many efforts are focused primarily a particular context and involve either learning environments or performance technologies. We decided that the best way to address the learning-working distinction was with transition pieces at the beginning and end of each of the two special issues, and to include some papers that responded specifically to this aspect of the special issue in each part. In this first part of the special issue, the full paper by Mulder, Swaak & Kessels and the short papers by Edmonds & Pusch, by Luke, by McKinnor & Geissinger, and by Tiedemann together represent how technology is contributing to blurring the distinction between learning and working. This dialogue will be continued in the second part of this special issue and will form the unifying theme in the final synthesis piece to the second part of this special issue.

All four of the issues indicated in the call for papers are addressed in both parts of the special issue. In addition to our own interest in how technology effects the learning-working distinction, it was our belief that technology integration ought to be addressed in the context of implications for design and development, frameworks for making effective use of new and emerging technologies, and cultural and social issues involved with new technologies. The next section of this introductory article discusses technology integration in general. The concluding section provides a preliminary framework for technology integration specifically constructed around the papers that comprise this special issue.

Discussion

What is technology integration all about? This roughly phrased but compelling questions is worth considering before leaping ahead to clarification of terms and identification of relevant distinctions. In the Turing award lecture to the Association for Computing Machinery, Dijkstra (1972) argued that computers had yet to solve a single problem - they had only introduced the new problem of learning to use them effectively. That argument was based partly on the lack of reusable and generalizable solutions and partly on the gap between innovation in computer technology and software engineering expertise. Our view is that the issue raised by Dijkstra (1972) in the context of software engineering remains one of the central problems with regard to learning environments and performance technologies - how to plan and implement technologies to effectively serve many users in a variety of situations. Consequently, we view technology integration as primarily about human use (Spector, 1994, 1995).

A human-centered perspective is crucial in understanding why particular technologies fail or succeed in various situations. Many books and articles have documented how the success or failure of promising technologies are closely related to various aspects of human use, both individual and social (see, for example, Jonassen & Reeves, 1996; Norman, 1998; Spector & Anderson, 2000). While it may appear obvious that technology integration is primarily about human use, it is often the case that technology integration issues are left to technical specialists to resolve without much interaction or involvement with others. According to advocates of user-centered approaches, especially the participatory design community, this is a formula for failure (Ehn, 1992; Nygaard, 1996; Schneiderman, 1998).

How technology becomes integrated into the daily learning and working lives of individuals, groups, organizations and society in general is a central theme of ETS and forms the framework for many large-scale research funding efforts, including the European Commission’s Fifth Framework Programme: Information Society Technologies, (for more information, see http://www.cordis.lu/ist/). In short, technology integration is an important area of concern for many different kinds of people working in many different contexts, including academics working in a variety of disciplines, many different kinds of organizations, and various governmental agencies. Effective public policy depends to a great extent on effective technology integration.

The goal of this special issue of ETS is to underline the importance of technology integration and to bring into the forefront the many dimensions of effective technology integration. The continued investigation of these dimensions in ETS and elsewhere will undoubtedly occur. It is our hope that this article and the papers that follow will contribute in a positive way to that dialogue. In the next several sections, we shall provide a rough definition for the keywords in our title as a precursor to the framework provided in the concluding section.
Technology

Dictionary definitions of ‘technology’ are based on its etymological roots in two Greek words: *techne* (art or skill) and *logos* (reason): technology involves the practical and systematic application of knowledge. Broadly conceived, technology involves the application of science to solve problems for individuals and organizations. This broad definition of technology makes no mention of tangible objects and is quite different from common use, which most often refers to items that can be touched and physically used in various ways (e.g., computers, personal digital assistants, and so on). Our view is that technology includes methods and techniques as well as tools and equipment. This broad interpretation encompasses computers, computer programs and algorithms but goes well beyond the integration of hardware and software to include both formal and informal methods and heuristics for use. The technology area of interest primarily involves information and communications technologies, again broadly conceived. Rather than belabor the discussion with an exploration of related terms, we postulate that a broad interpretation of technology is vital to the development of a scientifically sound and socially progressive perspective with regard to technology integration.

Integration

The etymology of ‘integration’ is from the Latin and involves the notion of restoration to wholeness. While there are special uses of ‘integration’, in this case the common use of ‘integration’ to refer to a process of combining various distinguishable parts to create a complex whole is sufficient for our purpose. Many taxonomies of educational objectives include mention of integration within the cognitive domain; some taxonomies make an effort to distinguish synthesis from integration (Anderson & Krathwohl, 2001). Rather than present a review of that literature, we adopt the view that integration involves combining disparate things in such a way to create a functional whole. When this process occurs within an individual, higher order thinking skills that include both analysis (the ability to differentiate things) and synthesis (the ability to identify causal and casual relationships among different things) are of primary concern. When this integration process occurs within a group or organization, cultural, psychological and social aspects arise. In both cases there is typically creative and constructive aspect, which is implied in the very notion of putting apparently different things together in such a way as to create an apparently unified whole.

This last idea deserves a bit more attention as it leads to a critical piece of our framework for thinking about technology integration. There is a certain tension between integration and holism. Both concepts involve the notion of multiple components. From the perspective of integration, multiple components are viewed as genuinely distinct and separate. The analysis of a situation involves the identification of these parts. The Cartesian (1637) method of breaking things into smaller and smaller units of analysis to be individually resolved prior to understanding the whole is based on this view. The integration goal is to find a way for truly different kinds of things to function as if they are one. From a holistic perspective, multiple components are not viewed as genuinely distinct and separate. The holistic goal is to see apparently different things as one - not as if they are one thing but simply as one thing with apparently distinguishable different manifestations. This tension might be characterized as that between Eastern and Western philosophies. The two editors of this special issue in fact represent Eastern (Chinese) and Western (American) culture. Our view, however, is that the apparent tension between integration and holism is resolved in the context of particular situations. It is often the case that in order to resolve a complex problem it is necessary to begin by collecting the various bits of information and experience available. What might happen is that things previously believed to be entirely distinct are understood in a different way as integral parts of a unified whole. In design situations, one often works the other way around and begins with a unified view and then creates components that will keep the whole intact and functioning appropriately. Adding clarifying examples is an interesting activity that we encourage readers to pursue.

We conclude this section with mention of activity theory (see Figure 1) as a means to bring together what we have said thus far about technology integration. From the perspective of activity theory, technology integration can be viewed in terms of individuals within a group, with various roles and responsibilities, working together with accepted norms and rules, using a variety of tools and creating a variety of artifacts, to achieve a common goal (Bødker, 1991; Leont’ev, 1978; Nardi, 1996). The notion of working within a community toward common goals is critical to effective technology integration and emphasizes the importance of user involvement in all aspects of technology design, development and deployment.
Learning

Definitions of learning typically include the notion of a process that brings about a relatively stable change in an individual or group. As we did with technology, we wish to adopt a broad interpretation of this term. We include both individuals and groups, although we do not wish to include machine learning in this discussion. We wish to include changes in directly observable aspects of an individual or group (e.g., behavior) as well as changes in those things that are only indirectly observable (e.g., mental models). We acknowledge that learning can occur in purposeful situations in which there is an explicit goal for an individual or group to learn as well as in incidental situations in which there is no explicit learning goal or interest. This is the familiar intentional-incidental distinction, of course, with instruction being that which is intended to support and facilitate intentional learning. Clearly technology can play an active role in intentional as well as in incidental learning. Regardless of whether the learning is intended or incidental or whether it involves changes in things directly or indirectly observable, if there is a claim that learning has occurred then it is reasonable to expect that the associated change(s) are relatively stable and persistent and that there is evidence that such change(s) in fact occurred.

Why is this broad notion of learning important? There are two reasons. First, the field of educational research has become polarized around a set of false issues (see Table 1).

The integrative aspect of this discussion leads to the compelling notion that knowledge and skill are closely intertwined when viewed from an activity perspective. When emphasis is on people solving problems to achieve a common goal, the notion of doing and understanding come together as a dynamic interaction. When the concern is with technology integration, theory and practice are inextricably intertwined. Creating artificial barriers among legitimate participants within an activity system is not likely to result in optimal outcomes.

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Table 1. False dichotomies (see Goodyear, 2000)

The second reason to accept our broad definition of learning is reflects the dynamic and complex nature of learning. There is not a single or simple view of human learning that accounts for what individuals and groups are able to master and understand (Sfard, 1998). Learning is complex and processes that lead to and support learning are likely to equally complex. Moreover, accepting the activity perspective with regard to learning leads one naturally to deemphasize the traditional distinction between learning and working and to emphasize goals and outcomes. This special issue in general reflects this perspective although not all of the contributors set out with that perspective in mind.

Working

Our definition of work is again within the context of human activity. Work involves an activity or related set of activities that require effort and are aimed at achieving one or more objectives. This familiar notion of work is consistent with an activity theory perspective in that multiple actors may be involved in multiple roles, operating with a variety of methods and tools, creating various artifacts that will contribute to achieving a common goal. Work is typically goal-directed. Work requires resources. Work requires effort. Effective group work often involves communication, cooperation, coordination and control, all of which can be made more efficient through the use of technology (Ganesan et al., in press).

The traditional distinction between learning and working involved individual learning and individual work. When emphasis is on intentional, individual learning, then it seems appropriate to stress the notion that there an individual is now able to do something outside the learning environment that was not possible prior to a sequence of learning experiences. When the emphasis is on individual work, then it seems appropriate to stress the notion of productivity and individual performance within the context of the work situation, which often involves the use of technology (job aids, electronic performance support systems, and so on). In the case of learning, technology might be aimed at bringing about relatively persistent changes in what an individual knows...
or is able to do. In the case of working, technology might be aimed at improving performance. The technologies involved might be quite similar. Moreover, in a work situation when individuals are using a particular performance technology, it often happens that learning occurs. Likewise, an individual’s performance is often enhanced after learning experiences.

In short, learning and performance technologies are closely related when viewed at the individual level. When viewed at the group and organization level, they may become practically indistinguishable. Much learning occurs on the job using the same technologies used to enhance performance the task at hand. Job-situated learning involves multiple actors in multiple roles. Moreover, in many cases there is a dynamic passage back and forth between working and learning, between problem solving and understanding, between informal discussions and formal work tasks, and so on. Discussions about life-long learning are beginning to recognize this breakdown in the traditional distinctions between learning and working (Jonassen et al, 2000). While this first part of the special issue on technology integration focuses on solutions in learning contexts, the foundation for the further blurring of working and learning are clearly being laid. We conclude with a brief description of an activity framework appropriate for the articles that comprise both parts of this special issue on technology integration.

Conclusion

Our framework is based on an activity system (see Figure 1).

![Activity System Diagram](image)

*Figure 1. An activity system (Nardi, 1996)*

An activity system makes explicit the notion of multiple actors in multiple roles, as members of a community of practice, using various tools to achieve shared goals. When the shared goal is to bring about a stable and persistent change in an individual or group, the activity system comprises what might be called a learning system. When the shared goal is to achieve a certain level of productivity, the activity system comprises what might be called a performance system. An activity system should not be viewed as a static system. While aiming to achieve performance or productivity goals, a group may engage in a focused learning effort that could also be characterized as a learning system within the larger performance system.

Given this activity perspective, we decided to group the articles comprising this first issue as follows:

- Full papers - generally address multiple aspects of the entire activity system.
- Short papers
  - Aspects of technology integration
Differing perceptions in school settings  
Cultural considerations  
Systems and environments  
Frameworks for evaluation and assessment  
Examples  
Individual differences/abilities  
Reviews

Synthesis - summarize the territory covered in this first part of the special issue with a look ahead to the second part of the discussion

In some cases, the links to the larger activity perspective are explicit and obvious, and in other cases they are less obvious. For example, the short papers in the cultural considerations group are generally concerned with the Community aspect of an activity system; the papers involving individual differences and abilities are generally focused on subjects and roles; the papers involving systems and environments are mostly about instruments and how they are used. We do not wish to impose too much of our own view on this collection papers since each is intended to tell a meaningful story and stand on its own. However, as editors we did want to encourage a larger view of these papers and those to follow in the second part of this special issue. Enjoy.

Note

The co-editors wish to acknowledge and express our most sincere appreciation for the strong support of the editor of ETS, Kinshuk, in bringing this special issue on technology integration to fruition.

References


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