Information Technology Diffusion/Integration

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Abstract: "Diffusion" and "Integration" are terms commonly used in the information technology and teacher education literature to characterize technology use in educational settings. This paper defines these terms and applies them to thinking about current trends in the field of instructional technology. Diffusion is conceptualized as "spreading" and "complete mixing;" Integration, as "combining" and "working together well." We categorize and present the themes in the past SITE conference papers that addressed diffusion and/or integration. Finally, we offer suggested questions and topics to address in future research to guide authors in submitting proposals to the Information Technology Diffusion/Integration section of SITE 2006.

Have you considered the difference between *diffusion* and *integration*? Are they interconnected or separate mechanisms? Are they actually mechanisms (actions) or achievements (states of being)?

Diffusion

In the dictionary, two definitions of *diffusion* are relevant:

> *diffusion* – (a) the spread of tools, practices, or other features from one culture to another; (b) the random movement of atoms, molecules, or ions from one site in a medium to another, resulting in complete mixing (Encarta, 1999)

These definitions highlight two concepts – "spreading" and "complete mixing" – that are vital to understanding diffusion. Situated within the Society for Information Technology and Teacher Education (SITE) organization, one might translate information technology diffusion as involving the spread of instructional technology tools, practices, and perspectives from one group (most likely the educational technologists and IT professionals) to other groups within teacher education (including but not limited to: content area and methods instructors, cooperative/collaborating teachers, student teaching/field supervisors). Yet, information technology diffusion goes farther than that. The field of teacher education is focused on initial preparation and life-long learning of preservice and inservice teachers *in order to impact K-12 students' learning and achievement*. Thus, the diffusion of instructional technologies within teacher education also aims to have a reverberating effect within K-12 educational institutions.

The instructional technology "tools, practices, and perspectives" being diffused have changed over the years. In the past, diffusion efforts focused on augmenting technologies and establishing Internet connectivity in K-12 schools and Schools/Colleges/Departments of Education (SCDEs). In the United States, funding programs such as E-rate offered supplemental funding resources for Internet infrastructure based on financial need of K-12 schools. The focus on equipping schools resulted in more technology resources. For example, in the United States, the ratio of 9 students per instructional computer in K-12 schools reported in 1997 (CEO Forum, 1997) has been reduced to 4.2 students per instructional computer in 2002 (NCES, 2005; Skinner, 2002). In fact, the number of students per instructional computer in the United States is nearly even in high poverty and low poverty schools (Technology Counts, 2001). Simultaneously, SCDEs also invested in infrastructure in order to prepare teachers for the

technologies they would encounter upon teacher placement. Diffusion, then, focused on spreading and supporting hardware, software, and connectivity throughout educational institutions. To what degree these resources are "mixed" or available equitably to all educational personnel within institutions is still a question open for research. Furthermore, the rate of technological change begs the question if "complete mixing" can occur prior to the next "technological wave."

We might also question what practices and perspectives (among teachers, teacher-educators, educational technologists, administrators and IT professionals) effectively support such equitable diffusion in today's educational contexts. For instance, past models of diffusion from business, sociology, and information science suggest that human behavior regarding technology use is affected by information richness and social pressures (Davis, Bagozzi & Warshaw, 1989; Davis, 1993), perceived ease of use (Straub, 1994; Cuban, 2001), as well as perceived usefulness, ability to see technology used in action, and triability (trying it in advance) (Rogers, 1995). Current research is needed that examines whether such models hold true given the increasing ubiquity of networked technologies in education and students' acceptance of them as an essential part of the way information is accessed, processed and communicated (Oblinger, 2003; Levin & Arafeh, 2002; Dede, 2005). What is needed is systematic examination of the additional extrinsic and intrinsic factors that influence different groups of technology users in the diffusion process (Cheung & Huang, 2005).

Currently, the field of instructional technology diffusion has shifted from an infrastructure focus to diffusion of meaningful technology practices. Of special importance is ensuring that all K-12 schools, regardless of degree of urbanicity or socio-economic level, experience and offer similar technology-supported learning activities to students. A digital divide of student technology use persists, for students in urban schools are more likely to use the computer for drill and practice or reward time activities rather than for problem-based activities that engage learners at higher cognitive levels (McAdoo, 2001). Similarly, at the collegiate/teacher education level, infrastructure diffusion now allows faculty to use technologies to maximize or transform learning activities in ways that enhance pedagogy or expand content materials. However, many SCDEs did not possess (and may still not) a clear vision of technology integration within their own institution (Mehlinger & Powers, 2002). Thus, "technology integration" was often limited to educational technology courses.

Integration

Furthermore, diffusion is connected with "instructional technology integration" efforts. The diffusion of hardware, software, and connectivity has expanded the pool of "technology integrators," those who attempt to learn and use technology to support student learning. No longer are we talking about "early adopters" of technology; we are observing and reading about instructors in all areas and at all academic levels learning to integrate technology. In *Contemporary Issues in Technology and Teacher Education (CITE)* the discussion of technology integration in teacher education, interestingly, is dominated by content and methods experts. Similarly, in *Learning and Leading with Technology (L&L)* K-12 subject matter practitioners have joined the conversation, describing ways they are using technology to improve subject matter learning.

The challenge in diffusing meaningful technology activities is to develop and identify meaningful activities. The definition of *integration* offers a simple foundation with which to begin.

> *integration* - a combination of parts or objects that work together well (Encarta, 1999)

The important concepts seem to be the "combining" and "working together well." As educators assume the challenge of integrating technology, they must combine their knowledge of instructional technology with their knowledge of content and pedagogy. And such a combination culminates in the development of technology supported activities, and such activities must work together and make sense.

Thus, research within the field of technology integration has shifted from studies of barriers to technology use to studies of the process of integrating technology into content. Within the latter studies, some topics include the processes of learning to integrate technology, the "value-added" or benefit of technology within technology supported activities, and of course, the impact of technology on student achievement. Despite the complexity of learning environments and, accordingly, the presence of countless confounding variables, we foresee more studies

that will try to examine the unique value of technology in students' learning and achievement – especially while the No Child Left Behind Act helps to set the educational research agenda in the United States. This new focus offers a new vantage point that may spur serious reflection by practitioners at all levels. In order to begin to answer questions about value-added and impact, one must examine new technology-supported curriculum, lessons, or interventions in detail to identify, first, " what is happening?" (Shavelson, Phillips, Towne, & Feuer, 2003). A developing methodology particularly apt for the field of technology integration is design experiments (Brown, 1992; Collins, 1992) or design-based research (Sandoval, Bell, & Sinatra, 2004; Kelly, 2003). This research methodology focuses on "those enterprises that involve intentional design coupled with empirical research and theorizing about what takes place in the authentic contexts where the designed objects come to be used" (Bell, 2004). Bell notes that "theory work" is a defining feature of the design experimentation enterprise and some complex interventions are also efforts to effect change. We anticipate that design experiments and design-based research will yield a vision of 'technology integration' that is built upon complex understandings of how technologies uniquely enhance curriculum, instruction, and students' learning in various contexts with multiple variables.

Call for Future Research

The research trends in diffusion and integration described in this paper relate primarily to the diffusion of technology use/integration within complex systems. However, we will continue to see diffusion of infrastructure within countries that have committed some focus and budget resources toward technology infrastructure development. In past SITE conferences, the papers included in the "Instructional Technology Diffusion/Integration" section of the *Proceedings* (2004) addressed diffusion, integration, or both. *Diffusion* papers (n=12), for instance, were primarily concerned with issues related to the expansion of technology use within educational institutions, including innovative technology tools for widespread dissemination, planning aspects related to diffusion, changes that occurred during diffusion and the rate of diffusion in countries that are still in the infrastructure development phase. Papers that fell into the *Integration* category (n=63) were spread across a wider range of topics. Most recounted, examined, or studied examples of "technology integration" or technology-supported learning and instruction, at the K-12 or higher education levels. They addressed issues such as technology integration in specific content areas, the processes related to learning to integrate, the impact on learning and knowledge, and variables that influenced individuals' adoption or use of technology. Finally, papers in the *Diffusion/Integration* category (n=18) explored issues of technology integration as well as diffusion of the described integration endeavors (i.e., the diffusion of electronic portfolios (the integrated innovation) into middle and secondary grades as well as evaluation of students' performance using such an assessment tool).We expect to see more examinations of technology's role in impacting student achievement in the coming years. Finally, we see both diffusion and integration to be actions as well as levels of accomplishment. Diffusion is an act of spreading and its culmination is complete mixing. Integration is an act of combining and its culmination is a combination that works well.

There is a wealth of interesting questions to ask about Instructional Technology Diffusion/Integration. Proposals submitted to the Information Technology Diffusion/Integration section of SITE 2006 might address the following questions and topics:

- How should we define "diffusion" and/or "integration" in today's educational contexts?
- What tools, practices, perspectives, factors influence and evolve the diffusion and/or integration process in certain settings?
- How can we think about diffusion more globally (i.e. how do practices in other countries compare; how are countries influenced by each others' practices)?
- Design experiments that yield rich case studies of technology integration interventions or diffusion accomplishments in particular settings.
- Design experiments that yield theoretical and conceptual development to direct future research in the field.
- What support systems (technical, social, cultural, other) are needed for diffusion or integration of technology to be successful?

- What models exist that predict successful integration of technology into classroom practices?

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