Activity Theory for Studying Technology Integration in Education

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INTRODUCTION

Information and communications technology (ICT) is rapidly changing the ways in which we do things. It has permeated almost every aspect of our society and has provided useful tools for communications, calculations, entertainment, design, and information gathering. As ICTs traverse traditional knowledge and communication barriers, many of the values of society are both enhanced and threatened. Using ICT has required new knowledge and skills; the instructors and students of today need many new skills to learn, work, and adapt to the ever-changing world. ICT is a subject of study and a tool to enhance study in other curricula areas. Technological literacy is defined as computer skills and the ability to use computers and other technology to improve learning, productivity, and performance. Successful technology integration is marked by students having access to an appropriate range of tools and being able to select and use them to help obtain information in a timely manner, to analyze and synthesize information and present it professionally in solving a problem. Technology integration should be an integral part of classroom culture.

Rogoff (1994) believes that technology can act as a catalyst influencing change from a traditional classroom to an environment of community of learners. A constructivist approach can be an effective way to successfully integrate technology in schools. The environment provides facilities for students to learn by doing, to work with others, and to have authentic experiences making learning motivating and relevant.

Research has found that there is very strong connection between appropriate teacher use of technology and increased student achievement (Valdez, McNabb, Foertsch, Anderson, Hawkes, & Raack, 2000). Technology integration is often concerned with classrooms. However, the real question must focus on integration into teaching practices, learning experiences, and the curriculum. Integration (from the Latin *integrare*, to make whole) includes a sense of completeness or wholeness and incorporates the need to overcome artificial separations by bringing together all essential elements in the teaching and learning process—including technology (as *one* of the elements, not the sole element) (Earle, 2002).

Technology provides cognitive tools for students as they make sense of the information gathered, allowing experts, teachers, and students to communicate their thoughts and interests in the subject matter and simulating real-life situations and problems. Many studies have been conducted to evaluate the effectiveness of teachers' integration of ICT in classrooms (Van Braak, 2001; Wetzel, 2001). Although these approaches have been successful, they lack exemplary use of ICT for instruction and learning (Jaber & Moore, 1999). There is a need to explore how teachers engage students in meaningful and beneficial learning and where the computer is seen as a part of everyday classroom activity (Dias, 1999). It is important to move beyond reporting on the factors that influence teachers to integrate ICT to how the interplay of these factors contributes to successful ICT integration by the teachers into the classroom.

As can be seen, successful integration of technology into the classrooms depends on many factors. How do we study the effectiveness of technology integration in schools? We believe that cultural historical activity

theory can be used as a framework to study the ICT integration processes in schools. This paper describes how learning activities in ICT-mediated classrooms must be understood in the context of larger socio-cultural issues. The structure of the paper is as follows. In the next section, we briefly review the use of technology for e-learning, followed by the impact of technology integration. A brief review of activity theory is then given, followed by how it can be used to study the effectiveness of technology integration. The final section of the paper presents the conclusion.

THE USE OF TECHNOLOGY FOR E-LEARNING

Since Galanter's first binary math tutorial in 1959, most early computer teaching was frame-based programmed instruction. Various audio and visual components were added as the technology became available, but development costs were extremely high. More cost-effective for vocational education were computer-based testing and tracking systems that guided learners through individualized instructional materials. Computer-based education and simulations were most cost-effective in specialty areas such as aviation or medical training where conventional methods were extremely costly or risky. In the 1980's, the installed base of micro-computers expanded and hardware and software standards emerged for the multimedia edutainment market. The uptake of computers in schools was rapid in response to a perceived need for widespread computer literacy training. Advances in networks such as BitNet led to widespread academic e-mail while dial-up bulletin boards paved the way for asynchronous chats, thus a ready market existed for the surge in a public Internet that started in 1995 with the appearance of easy-to-use graphical Web browsers and content creation tools.

The term "e-learning" came into popular use after the claim it "would make e-mail look like a rounding error" (Chalmers, 1999). Web sites were implemented to support both face-to-face and distance instruction so that within 10 years most tertiary education courses came to use some form of Web support. Most e-learning today uses the Web to facilitate communications and interactions among the learners and with the instructor. Much of it occurs in a hybrid or "blended" environment that still has a face-to-face component. The low cost of mounting Web-based courses has also threatened the existence of more traditional distance education organizations (Abrioux, 2006). Although computers are now common in schools and at home, in the K-12 sector distance e-learning has only taken hold in homeschooling and in small schools mostly in rural or minority language settings where there are insufficient student numbers to have content specialist teachers present for every subject. ICTs have so successfully become part of the educational milieu that the term e-learning itself is beginning to be considered as anachronism.

Bransford, Brown, and Cocking (2000, p. 207) note five ways in which new technologies can be used:

1. Bringing exciting curricula based on real-world problems into the classroom.
2. Providing scaffolds and tools to enhance learning.
3. Giving students and teachers more opportunities for feedback, reflection, and revision.
4. Building local and global communities.
5. Expanding opportunities for learning.

Each of these poses an opportunity for technology integration, and successful integration will see growth in both technology skills and content knowledge. ICTs provide access to up-to-date resources and diverse views on current events in culture, social studies and science, or even become virtual participants on remote field trips. The integration of metacognitive tools into information retrieval interfaces (Winne et al., 2005) demonstrates how successful integration can scaffold and influence learners' approaches to learning. While drill and practice are less common in formal instructional programs, they are a mainstay of many educational computer games where "twitch speed" must be combined with strategic reflection to achieve goals. Learners are encouraged to reflect on their personal progress and goals in e-portfolios.

Community building is not constrained to distance education but is also important in local work groups forming collective concept maps for knowledge building exercises (Scardamalia, 2003), for allowing novices to compare knowledge maps with those of experts, or in pairing classes for the exchange of meaningful second-language communications. A plethora of information is available on the Internet, and motivated learners