Theoretical Foundations for Educational Multimedia

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INTRODUCTION

The notion of using technology for educational purposes is not new. In fact, it can be traced back to the early 1900s during which time school museums were used to distribute portable exhibits. This was the beginning of the visual education movement that persisted through the 1930s as advances in technology such as radio and sound motion pictures continued. The training needs of World War II stimulated serious growth in the audiovisual instruction movement. Instructional television arrived in the 1950s, but had little impact, mainly due to the expense of installing and maintaining systems. The advent of computers in the 1950s laid the foundation for CAI (computer assisted instruction) through the 1960s and 1970s. However, it was not until the 1980s that computers began to make a major impact in education (Reiser, 2001). Early applications of computer resources included the use of primitive simulation. These early simulations had little graphic capabilities and did little to enhance the learning experience (Munro, 2000).

Since the 1990s, there have been rapid advances in computer technologies in the area of multimedia production tools, delivery, and storage devices. Throughout the 1990s, numerous CD-ROM educational multimedia software was produced and was used in educational settings. More recently, the advent of the World Wide Web (WWW), together with the emergence of mobile devices and wireless networking, has opened a vast array of possibilities for the use of multimedia technologies and associated information and communications technologies (ICT) to enrich the learning environment. Today, educational institutions are investing considerable effort and money into the use of multimedia. The use of multimedia technologies in educational institutions is seen as necessary for keeping education relevant to the twenty-first century (Selwyn & Gordard, 2003).

The term "multimedia" as used in this article refers any technologies which make possible "the entirely digital delivery of content presented by using an integrated combination of audio, video, images (two-dimensional, three-dimensional) and text" along with the capacity to support user interaction (Torrisi-Steele, 2004, p. 24). Multimedia may be delivered on computer via CD-ROM, DVD, the Internet, or on other devices such as mobile phones and personal digital assistants, or any digital device capable of supporting interactive and integrated delivery of digital audio, video, image, and text data.

The notion of interaction in educational multimedia may be viewed from two perspectives. First, interaction may be conceptualised in terms of "the capacity of the system to allow individual to control the pace of presentation and to make choices about which pathways are followed to move through the content; and the ability of the system to accept input from the user and provide appropriate feedback to that input" (Torrisi-Steele, 2004, p. 24). Second, given the integration of multimedia with communication technologies, interaction may be conceptualized as communication among individuals (teacher-learner and learner(s)-learner(s)) in the learning space that is made possible by technology (e-mail, chat, video-conferencing, threaded discussion groups, and so on).

The fundamental belief underlying this article is that the goal of implementing multimedia into educational contexts is to exploit the attributes of multimedia technologies in order to support deeper, more meaningful learning. Furthermore, if multimedia is effectively integrated into educational contexts then teaching and learning practice must necessarily be transformed (Torrisi-Steele, 2004). It is intended that this article will serve a useful starting point for educators beginning to use multimedia. The article attempts to provide an overview of pedagogical perspectives relevant to the effective integration of multimedia technologies in educational contexts. First, constructivism and social constructivism are discussed as the currently dominant frameworks for the design of multimedia learning en-

vironments. Following this, connectivism is discussed as an emerging paradigm. Finally, some important professional development issues are highlighted.

PEDAGOGICAL PERSPECTIVES

Traditionally, teaching practices have focused on knowledge acquisition, direct instruction, and the recall of facts and procedures. This approach suited the needs of a society needing "assembly line workers" (Reigeluth, 1999, p. 18). However, in today's knowledge-based society, there is a necessity to emphasise deeper learning such as that which occurs through creative thinking, problem solving, analysis, and evaluation, rather than the simple recall of facts and procedures emphasised in more traditional approaches (Bates, 2000). Educators have heralded the advent of multimedia technologies as a catalyst for change in traditional teaching practices; to innovate and improve on traditional practices (LeFoe, 1998; Relan & Gillani, 1997). The move away from traditional teaching practices is conceptualized as a move from a teacher-centred instructivist perspective, to a learner-centred constructivist perspective on teaching and learning.

The constructivist perspective has been widely accepted as the guiding philosophy for design of educational multimedia applications (Strommen, 1999, p. 2). Constructivism describes a "theory of development whereby learners build their own knowledge by constructing mental models, or schemas, based on their own experiences" (Tse-Kian, 2003, p. 295). The constructivist view embodies notions that are in direct opposition to the traditional instructivist teaching methods that have been used in educational institutions for decades (Table 1).

Using the constructivist views as a foundation, the key potentials of multimedia to facilitate constructivist learning are summarised by Kramer and Schmidt (2001, p. 196) as:

- Cognitive flexibility through different accesses for the same topic
- Multimodal presentations to assist understanding, especially for learners with differing learning styles
- "Flexible navigation" to allow learners to explore "networked information at their own pace" and also provide rigid guidance if required
- "Interaction facilities provide learners with opportunities for experimentation, context-dependant feedback and constructive problem solving"
- Asynchronous and synchronous communication and collaboration facilities to bridge geographical distances
- Virtual laboratories and environments can offer near authentic situations for experimentation and problem solving

The prevalence and availability of communication technology has precipitated a transition in focus from the constructivist perspective in general towards social constructivism and the associated approaches of collaborative learning and the construction of learning communities. The social constructivist perspective as formulated by Lev Vygotsky (1978) emphasises the importance of interaction with peers, teachers and experts in a collaborative learning community. (Tse-Kian, 2004, p. 295). Collaborative learning and the notion of establishing learning communities has become a significant focus in the design of online educational multimedia environments (Dawson, 2006). Tools for the establishment of learning communities include synchronous (chat, internet relay chat, video conferencing, and so on) and asynchronous (e-mail, bulletin boards, threaded discussion groups, and so on) communication. Members of learning communities share a common goal that is achieved by working together and potentially building new knowledge in the process (Kilpatrick, Barrett, & Jones, 2003).

Beyond social constructivism, George Siemans (2005a) has proposed "connectivism" as a new paradigm for learning in the "digital age." The connectivism perspective draws attention to the importance of knowledge navigation rather than knowledge creation as a key learning goal. . Siemans stresses that in today's digital society, "learning is no longer an internal, individualistic activity" (Siemans, 2005a). Learning may reside outside of the individual within an organization or a database. Knowledge is growing exponentially and has become more informal and dynamic. The life of knowledge today is measured not in decades, but in months and years. In the face of vast volumes of rapidly changing knowledge, the emphasis in learning must be directed towards self-organization and "the capacity to form connections between sources of information and thereby create useful information patterns" (Siemans, 2005a). The ability to recognise and adjust patterns