Chapter 23
Preparing Teachers to Integrate Technology Effectively:
The Case of Higher-Order Thinking Skills (HOTS)

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ABSTRACT

Technology has the greatest impact on student learning outcomes when students complete technology-rich activities that also develop their higher-order thinking skills (HOTS). This chapter presents findings from a study that examined two lesson plans from 74 first-year teachers who were learning how to plan technology-rich instruction focused on students' HOTS. Findings indicate that teachers' lesson plans did not address students' HOTS and rated low on the Level of Technology Integration (LOTI) scale. Further, teachers' use of an indirect instruction lesson plan format that promoted student discovery was associated with higher levels of HOTS and technology use. Implications and future trends for both practice and research are also shared.

INTRODUCTION

Technology Integration

Technology integration continues to be a popular topic to discuss among scholars, policy makers and educators. While the influence of technology on student learning has yielded mixed results, many maintain that educational technologies hold the key to improving student achievement (Bransford, Brown, & Cocking, 2000; U.S. Department of Education [USDE], 2004) and the future of our nation (Friedman, 2005; Gladwell, 2002). While research has yielded mixed results on the influence of technology on learning, numerous studies highlight the need for technology-rich learning activities to also develop students' higher-order thinking skills (HOTS) (e.g., Mann, Shakeshaft, Becker, & Kottkamp, 1999; Ringstaff & Kelley, 2002; Roschelle, Pea, Hoadley, Gordin, & Means, 2001; Schacter, 1999; Wenglinsky, 1998). It has proven problematic for researchers to establish relationships between technology and student

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learning without accounting for the manner in which technology is used (Roschelle et al., 2001).

In a large-scale analysis of data from the National Assessment for Education Progress, Wenglinsky (1999) found that technology use was only associated with gains in student learning in the context of activities that developed students' higher-order thinking skills. This finding has been confirmed with other research about technology-rich authentic learning environments (Cognition and Technology Group at Vanderbilt [CTGV], 1997), reading programs (Knezek & Christensen, 2007) science inquiry environments (Dunleavy & Hienecke, 2007), and mathematics problem solving (Bransford, Brown, & Cocking, 2000; Polly, 2008-a). Other studies indicate that technology impacts learning positively when associated with learner-centered activities, such as when students use technology to facilitate problem solving, conceptual development, and critical thinking (CTGV, 1997; Means, 1994; Ringstaff & Kelley, 2002; Wenglinsky, 1998).

Therefore, if educational technologies are going to impact student learning, the use of these must be embedded in activities where technology serves as a tool to support learning (Jonassen & Reeves, 1996; ISTE, 2008), and develop students' higher-order thinking skills (Bransford, Brown, & Cocking, 2000; ISTE, 2008).

Higher-Order Thinking Skills

Higher-order thinking skills (HOTS) are not new to education. In 1956, Benjamin Bloom and some of his colleagues created Bloom's Taxonomy, which categorized types of educational tasks according to cognitive difficulty. Students' actions were the focal point of the taxonomy.

Marzano (1988) modified Bloom's Taxonomy with his own framework. Most recently, Anderson and Krawthwohl (2000), two of Bloom's co-authors, revised the original Bloom's Taxonomy. The taxonomy lists the process of Creating at the highest level. Creating, is the process of "putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure" (Anderson and Krawthwohl, 2000). This process of creating serves as a natural fit with educational technology and the advancements of the past few decades, where scholars have advocated for students to learn content by building and creating representations of knowledge (Harel & Papert, 1991; Kafai & Resnick, 1996).

Recommendations for reforming PK-12 schools include developing students' HOTS, in addition to teaching from a more learner-centered manner (Bransford, Brown, & Cocking, 2000; Cornelius-White & Harbaugh, 2009; McCombs, 2003; McCombs & Whisler, 1997). McCombs and Whisler (1997) published recommendations (see Table 1) for K-12 schools based off the empirically-based learner-centered principles published by the American Psychological Association (APA Work Group, 1997). According to McCombs and Whisler (2003), teachers should:

- Pose tasks that were relevant to learners,
- Allow students to direct their learning and take more ownership of tasks
- Promote reflection
- Embed assessment within a task
- Allow resources such as technology to be used to support learning,
- Facilitate learning during class,
- And create a positive environment that encourages collaboration.

While research indicates that learner-centered instruction contributes to gains in student learning outcomes (Cornelius-White, 2007), there have been barriers teaching in this manner. Research shows that teachers struggle to teach in ways that are learner-centered and focus on students' HOTS (Fishman, Marx, Best, & Tal, 2003; Schneider, Blumenfeld, & Krajcik, 2005). In some cases, teachers reverted to traditional approaches when