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How Technology Fosters Learning: Inspiration from the "Media Debate"

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Abstract

Early back in 1994, Ross (1994) pointed out the issue of debate on media effect was not trifling, but bore great significance for how researchers and practitioners ponder on the implementation of media. Despite technology has come of age, the debate has recurred on the role of technology in education. This article tries to revisit and analyze the media debate between Richard E. Clark and Robert B. Kozma, and through the development of technology, multimedia learning theories and current findings from empirical studies on technology-enhanced learning, propose our viewpoint of how technology fosters learning, a tripartite structure of effective technology-enhanced learning. This tripartite structure indicates that the design of technology-enhanced learning environment should concurrently consider learner characteristics, technology attributes and instructional methods. This facilitates learners in achieving upmost learning effectiveness.

Keywords

**Media Debate, Technology-Enhanced Learning, Tripartite Structure of Effective
Technology-Enhanced Learning**

1. Introduction

Thanks to the advancement of technology and policy support for information education, technology is plotting new directions for education with its abundant potential (Linn, 2003). Educators and the general public alike yearn to see technology exploited to the fullest. However, using technology to facilitate learning remains a controversial topic, with a multitude of research findings indicating both advantages and disadvantages (e.g. Jones,

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2003; Jaggars & Bailey, 2010). Hence the contention that technology improves learning effectiveness remains controversial.

As early as 1994, Ross (1994) observed that the debate on the effect of media was not trivial, but bore great significance for how researchers and practitioners construct the application of media. Ross therefore assembled a special issue on the media debate between Richard E. Clark and Robert B. Kozma to inspire a comprehensive discussion of the topic. Technology-enhanced learning, growing out of audio tutorial instruction in the 80s, has expanded from CBI and CAI to ICT (Information and Communication Technology). Though technology has come of age, the debate on the effect of technology on education has simply risen anew (Wellington, 2005). Given this, the authors revisit and analyze the media debate between Clark and Kozma, and through the development of technology, multimedia learning theories and current findings from empirical studies on technology-enhanced learning, propose a viewpoint on how technology fosters learning.

2. The Arguments of Clark and Kozma

In the debate over whether and how media influence learning, Clark and Kozma tackled the issue from different angles. Their arguments were based on media analyses that explored which media and methods were crucial in affecting learning. Through meta-analysis and evidence from research on media attributes, Clark (1983) emphasized instructional methods in facilitating learning. Kozma (1991) took the reverse position. He contended that media attributes complement the process of learning by approaching the issue from how learning occurs, reflect the contribution of various media or media attributes in constructing and shaping the learner's mental model.

Clark (1994a) argued that there was no direct relationship between media and learning. He reviewed Gagne, Briggs, & Wager (1992) and Salomon (1984), and then concluded that external instructional events affect learning. According to Gagne et al. (1992), by comparison with the internal operation of cognitive information, events that stimulate or support internal processes such as gaining attention, eliciting performance (practice) and providing feedback are termed external instructional events (instructional methods). As media possess functions that draw the learner attention or activate learner motivation, Gagne et al. viewed media as a communication or stimulus carrier and not as an external instructional event. In addition, Clark cited Salomon (1984) and further attributed motivation to the learners' beliefs and expectations about their reactions to external instructional events, not to external instructional events alone. In other words, Clark discarded media from external instructional events, and stated that media cannot directly affect learning.

By contrast, Kozma (1991) did not consider learning a receptive reaction to the delivery of instruction. To Kozma, learning is an active and constructive cognitive and social process, during which the learner's cognitive resources and the external environment reciprocate each other to build knowledge and learning. This interaction is strongly influenced by the level of coordination between the two elements (Kozma, 1994). This viewpoint affirms that a relationship exists between media and learning, a relationship that has roots in the cognitive and social processes where knowledge is being constructed.

In the media debate, Clark (1983, 1994a) argued that it was the instructional methods that influence learning, while Kozma (1991) held that media attributes simultaneously realize and restrain instructional methods. Kozma contended that learners acquire learning through interacting with both media and instructional methods. In Kozma's view, media attributes and the learning process complement each other, and the former enables learners to construct presentations and shape, elaborate, or modify their mental models.

3. Progress of Learning Theories and Media Attributes Since the 1990s

Clark (1994b) argued that the variable of media had never been shown to be effective and that no known cognitive learning theories embraced media and media attributes. Nonetheless, the revolution in learning psychology and progress in the cognitive psychology of instruction since the 1990s shifted the focus to the learner (Jonassen, Campbell, & Davidson, 1994). Mayer (2003) chose to establish the cognitive theory of multimedia learning based on the foundation of the cognitive process of individual learner. Building on his research, Mayer constructed his theory using three hypotheses: dual channel, limited capacity, and active learning, and elucidated how an individual learner was engaged in learning via multimedia. The cognitive theory of multimedia learning placed greater emphasis on the effects of learner characteristics on multimedia learning and enriched the theoretical basis of media studies.

Compared to media and learning research prior to the 1990s, the expansion of computer technology and the Internet has brought tremendous change to instructional practice (Hastings & Tracey, 2005). Krajcik & Czerniak (2007) argued that technology based on computers is a tool of cognition, Internet can assist information collection and sharing, and 3D images can facilitate visualizing information; thus technology should be fully utilized to support students' active exploration of phenomena, allowing students to enrich their scientific concepts and become familiar with science applications during their participation in activities. Research on technology advancement and technology-enhanced learning over the last two decades has generated greater support for the contention that learning environment built by technology fosters students' scientific concepts, and their development of ability about investigating practical matters and nature of science (Krajcik & Czerniak, 2007; Linn, 2003), essentially substantiating Kozma's view of media attributes.

4. Our Viewpoints on Media, Technology and Learning

The advancement of technology and Internet in recent years has provided ample evidence for the contention that learning is assisted by media attributes. Nevertheless, current instructional methods and strategies for most instructional media are still compatible with those of 1983, meaning that the media debate continues (Hastings & Tracey, 2005). Technology *per se* does not influence learning, and only with effective instructional methods and design can it facilitate learning. A good example is the current 3D technology fad. 3D instructional design tools can easily lead to the development of general 3D games or movies for entertainment if not carefully designed and planned based on instructional theories, reducing their benefits for learning. As Kozma (1991) observed, a good design incorporates media and instructional methods, and the two often affect learning through their influence on each other. Therefore, in the media debate, both Kozma's views about media attributes and Clark's observations on the persistence of instructional methods are correct. Yet both viewpoints paid little attention to the role of learners in media environment and their cognitive processes. The cognitive theory of multimedia learning (Mayer, 2003), on the other hand, pivots on learners' cognitive processes in multimedia learning environments. Mayer's theory implies that learner characteristics have an effect on learning. In addition, the media used for facilitating teaching and learning are always technology-enhanced and are named learning technology in recent years. The authors therefore incorporate learner characteristics pertaining to learning into the authors' stance as one of the essential factors for the subject of technology-enhanced learning. Based on the foregoing discussion, the authors propose a tripartite structure of effective technology-enhanced learning (**Figure 1**). The influence technology possesses on learning should take into account three major factors: learner characteristics, instructional methods, and technology attributes in bringing technology-enhanced learning advantages into full play.
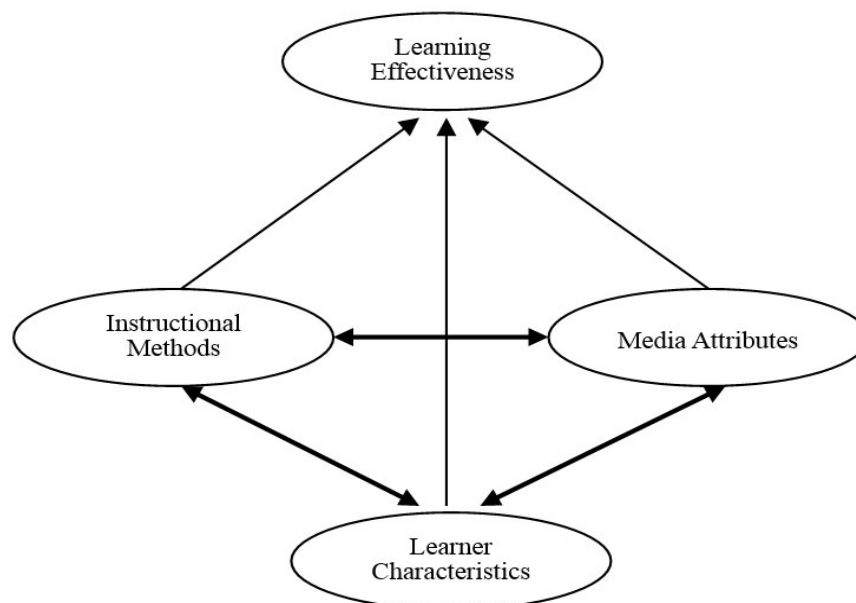

Figure 1. Tripartite structure of effective technology-enhanced learning.

The authors argue that learner characteristics, instructional methods, and technology attributes mutually influence learning and that only when those three components are taken into consideration will a technology-enhanced learning environment manifest its virtues.

5. Conclusions

The unprecedented development of technology ensures that the application of technology in education will continue to evolve (Wellington, 2005). However, the chronicle of educational technology illustrates that technology is constantly being introduced into the field of education, but when the frenzy fades, serious examination more often than not shows that technology has no great influence on learning (Reiser, 2001). This repeated phenomenon makes the issues of technology-enhanced learning continue to be discussed and researched (Hastings & Tracey, 2005; Wellington, 2005).

The literature review of the media debate shows that Clark and Kozma, based on different views on learning and media attributes, and using different evidence, meta-analysis and research on the interaction between media and learners, put forward their respective arguments on how media influence learning. However, the advancement of technology and learning theories, coupled with an abundance of empirical studies in the field over the past twenty years, have enriched the construction of media and its attributes. Because learners are the subject of learning, the authors contend that the media debate should not be confined to instructional methods and media attributes, but should include the discussion of learner characteristics. The authors therefore propose a tripartite structure of effective technology-enhanced learning as the contribution to the ongoing debate.

There are several limitations of the model of the tripartite structure of effective technology-enhanced learning proposed herein. This model faces limitations since the presentation model of media expands as technology progresses. The presentation model of media and instructional methods reciprocate each other to influence learning. In addition, the learner is a core influence on the benefits of technology-enhanced learning. The most extensive discussion of learner characteristics in the current technology-enhanced learning environment contains learning preference, learning style, cognitive style, and prior knowledge (Chen & Paul, 2003). However, the scope of learner characteristics is growing with the expansion of studies of technology and cognitive psychology, and as more innovative research methodologies (e.g. neuroscience and eye-tracking technology) are created. Thus, research topics originating from the interaction of learner characteristics, different technology attributes, and various instructional methods evolve with revision of technology and methodology, and become both more diverse and more copious. These expanding topics invite scholars of technology-enhanced learning to perform more profound investigation. The findings may challenge the model laid out in the tripartite structure of effective technology-enhanced learning.

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