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Review

How features of educational technology applications affect student reading outcomes: A meta-analysis

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ABSTRACT

The purpose of this review is to learn from rigorous evaluations of alternative technology applications how features of using technology programs and characteristics of their evaluations affect reading outcomes for students in grades K-12. The review applies consistent inclusion standards to focus on studies that met high methodological standards. A total of 84 qualifying studies based on over 60,000 K-12 participants were included in the final analysis. Consistent with previous reviews of similar focus, the findings suggest that educational technology applications generally produced a positive, though small, effect (ES = +0.16) in comparison to traditional methods. There were differential impacts of various types of educational technology applications. In particular, the types of supplementary computer-assisted instruction programs that have dominated the classroom use of educational technology in the past few decades were not found to produce educationally meaningful effects in reading for K-12 students (ES = +0.11), and the higher the methodological quality of the studies, the lower the effect size. In contrast, innovative technology applications and integrated literacy interventions with the support of extensive professional development showed more promising evidence. Although many more rigorous, especially randomized, studies of newer applications are needed, what unifies the methods found in this review to have great promise is the use of technologies in close connection with teachers' efforts.

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1. Introduction

The classroom use of educational technology such as computers, interactive whiteboards, multimedia, and the internet, has been growing at a phenomenal rate in the last two decades. According to a recent survey conducted by the U.S. Department of Education (SETDA, 2010) on the use of educational technology in U.S. public schools, almost all public schools had one or more instructional computers with internet access, and the ratio of students to instructional computers with internet access was 3.1–1. In addition, 97% of schools had one or more instructional computers located in classrooms and 58% of schools had laptops on carts. A majority of public schools surveyed also indicated their schools provided various educational technology devices for instruction: LCD (liquid crystal display) and DLP (digital light processing) projectors (97%), digital cameras (93%), and interactive whiteboards (73%). The U.S. Department of Education provides generous grants to state education agencies to support the use of educational technology in K-12 classrooms. For example, in fiscal year 2009, the Department made a $900 million investment in educational technology in elementary and secondary schools (SETDA, 2010).

The debate around the effectiveness of educational technology for improving student learning has been carried on for over three decades. Perhaps the most widely cited debate was between Clark (1983) and Kozma (1994). Clark (1983) first argued that educational technology had no impact on student learning under any condition and that "media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition". He continued to argue that the impact of technology on student learning was mainly due to novelty effects or instructional strategies, but not technology itself. Kozma (1994) responded to Clark's argument by saying the analogy of "delivery truck" creates an "unnecessary schism between medium and method". Kozma believed that technology had an actual impact on student learning and played an important role in student learning.

The Clark–Kozma debate of the 1980's has been overtaken by the extraordinary developments in technology applications in education in recent years. It may be theoretically interesting to ask whether the impact of technology itself can be separated from the impact of particular applications, but as a practical matter, machine and method are intertwined. As is the

Table 1
Summary of major meta-analysis in education technology.

Reviews	Grade	Number of studies	Effect sizes
Kulik and Kulik (1991)	K-12	18	+0.25
Becker (1992)	K-8	10	+0.18
Ouyang (1993)	K-6	20	+0.16
Fletcher-Finn and Gravatt (1995)	K-12	23	+0.12
Soe et al. (2000)	K-12	17	+0.13
Blok et al. (2002)	K-3	42	+0.19
Kulik (2003)	K-6	27	+0.06–0.43

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