Computers & Education 96 (2016) 15–28

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Technology-supported student interaction in post-secondary education: A meta-analysis of designed versus contextual treatments

Eugene Borokhovski [a, *], Robert M. Bernard [a], Rana M. Tamim [b], Richard F. Schmid [a], Anna Sokolovskaya [a]

[a] Centre for the Study of Learning and Performance, Concordia University, Montreal, QC, Canada
[b] Zayed University, College of Education, Dubai, United Arab Emirates

ARTICLE INFO

Article history:
Received 9 June 2015
Received in revised form 26 October 2015
Accepted 8 November 2015
Available online 12 November 2015

Keywords:
Media in education
Improving classroom teaching
Teaching/learning strategies
Postsecondary education
Interactive learning environments

ABSTRACT

The present study extends the results of a larger meta-analysis that addressed the effects of technology use on student achievement and attitudes in postsecondary education. The focus of the current meta-analysis is the use of technology to enable instructional conditions that promote collaborative interactions among learners. More specifically, it aims to compare the impact of designed interaction treatments (i.e., collaborative activities intentionally built into course design) and contextual interaction treatments (i.e., course conditions that result in high levels of student–student interaction but are not intentionally designed to promote collaboration) on student learning outcomes. Results indicate that designed treatments outperform contextual treatments ($\overline{g} = 0.52$, $k = 25$ vs. $\overline{g} = 0.11$, $k = 20$, $Q_{Between} = 7.91$, $p < .02$) on measures of achievement, emphasizing the importance of planning and instructional design in technology integration in postsecondary education. The results are discussed in relation to the literature of student–student interaction and collaborative learning.

1. Introduction

This review extends a larger meta-analysis of the comparative effectiveness of technology integration in postsecondary education (Schmid et al., 2014). It uses a subset of research from the database of the original meta-analysis, but extends coding of selected study characteristics with the goal of clarifying and advancing some of Schmid and colleagues' major findings. In addition to establishing the fact that institutions of higher education continue to take advantage of developments in computer and communication technologies, as is reflected in the overall small but statistically significant average effect size, Schmid and colleagues studied various functions of technology use and found largely in favor of those instructional tools that provided students with cognitive support for learning. The current review takes a further step in exploring under what instructional conditions the use of various technological tools in postsecondary classrooms helps to achieve better educational outcomes. Specifically, it addresses the promising outcomes that arose from Schmid et al. (2014) with regard to the

* Corresponding author. GA 2.125, 1455 de Maisonneuve Blvd. W., Montreal, QC H3H 1H5, Canada.
E-mail addresses: eborokhovski@education.concordia.ca (E. Borokhovski), bernard@education.concordia.ca (R.M. Bernard), rana.tamim@zu.ac.ae (R.M. Tamim), schmid@education.concordia.ca (R.F. Schmid), a.sokolo@gmail.com (A. Sokolovskaya).

http://dx.doi.org/10.1016/j.compedu.2015.11.004
0360-1315/

effects of technology in supporting communication and interaction among students. Additional study features coding and refined analyses were carried out to separate the influence of *designed* and *contextual interaction treatments* as they are facilitated by technology use. Several theoretical perspectives, briefly outlined in the upcoming sections, will help shape a rationale for this analytical approach by putting it into the context of educational research on student interaction and collaborative learning.

1.1. Theoretical perspectives

1.1.1. Student interaction in distance education

Regardless of a particular instructional delivery form, student interaction with instructors, other students, and content is widely regarded as fundamental in today's classrooms. The importance of these three types of interactions has been particularly recognized in various theoretical frameworks on distance and online education because of the separation in space and/or time of students from their teachers and peers (Anderson, 2003; Beldarrain, 2006; Moore, 1989). This separation in distance education demands the use of either asynchronous or synchronous technology for students and teachers to interact and subsequently collaborate. The importance of student–student interaction has been demonstrated in several topical meta-analyses. In examining undergraduate distance education courses, Lou, Bernard, and Abrami (2006) found a link between student–student interaction and greater achievement success ($\bar{g} = 0.11$, $k = 30$, $p < .05$). Furthermore, student–student interaction was found to be a significant predictor of student achievement in multiple meta-regression ($R^2 = 17.97\%$ of total variance accounted for). Later, in a more direct test of the three kinds of interaction treatments (i.e., student–student, student-teacher, and student-content), Bernard et al. (2009) demonstrated an explicit link between interaction and academic performance in distance education. All three forms of interaction treatments were found to positively and significantly improve learning, with student–student interaction being the most important among the three ($\bar{g} = 0.49$, $k = 10$, $p < .05$).

Nevertheless, the likely assumption among educational practitioners that providing students with opportunities to interact with each other will automatically translate into successful collaboration has not been supported by research findings. Referring to findings from the meta-analysis just described, Abrami, Bernard, Bures, Borokhovski, and Tamim (2011) remarked:

[J]ust because opportunities for interactions were offered to students does not mean that students availed themselves of them, or if they did interact, that they did so effectively. The latter case is the more likely event, so the achievement effects resulting from well-implemented interaction conditions may be underestimated in our review (p. 86).

The validity of the above argument was further investigated by Borokhovski, Tamim, Bernard, Abrami, and Sokolovskaya (2012) by selecting student–student interaction studies from the original meta-analysis (Bernard et al., 2009) and assessing them on markers of collaborative activities. The hypothesis was that enhanced learning would occur in distance education contexts if instructional strategies were set up to maximize student–student interaction to enable collaboration (i.e., *designed interaction treatments*). Contrasted with these treatments were conditions where the context of instruction (whether technological or organizational) simply provided students with opportunities to interact without any intentional efforts to introduce elements of collaboration in the course design (i.e., *contextual interaction treatments*). Specifically, Bernard et al. (2009) used Moore's (1989) distinction among three types of interaction in distance education (i.e., student-teacher, student-content, and student–student) to test the related hypothesis about the joint effects of their various combinations (Anderson, 2003). Special attention was paid to student–student interaction, understood as communications among individual students or among students working in small groups. In the context of modern distance education, student–student interaction, enriched by technology, may occur either synchronously (e.g., video-conferencing) or asynchronously (e.g., discussion boards), but almost inevitably has an impact on student cognition and motivation (e.g., Abrami et al., 2011; Kanuka & Anderson, 1999). Borokhovski et al. (2012) further defined *designed* and *contextual interaction treatments*, respectively, as: (1) intentionally planned and implemented collaborative instructional activities that are intended to increase student learning; and (2) instructional settings that contain the necessary conditions for student–student interaction to occur, but are not intentionally designed to create collaborative learning environments.

More elaborate coding, designed to capture relevant study characteristics, and subsequent analyses revealed significant average effect sizes for both types of interaction treatments (i.e., $\bar{g} = 0.50$, $k = 14$, $p < .01$ and $\bar{g} = 0.22$, $k = 22$, $p < .05$ for designed and contextual, respectively). More importantly, *designed interaction treatments* significantly outperformed *contextual interaction treatments* ($Q_{Between} = 6.37$, $p < .01$), thus supporting the hypothesis that instructional design and planning encourage students to avail themselves of the opportunity to interact and collaborate more effectively and productively. A question remains, however, as to whether these conditions that manifested themselves in the context of distance education, given the overall importance of interaction there, also apply to classroom technology integration.

1.1.2. Technology-supported student interaction in postsecondary education

The case for distance education is compelling because interaction and collaboration are highly dependent on the use of technology, which is not as true for face-to-face postsecondary education contexts. While technology use within classroom instruction may enhance certain aspects of the learning process, its presence is much less of a necessity for ensuring interaction and collaboration. With this in mind, the question is whether the notion of technology-supported student–student interaction, drawn from the distance education literature, carries over into face-to-face instructional settings. Some evidence is provided by Fjermestad (2004), who analyzed 145 experiments investigating synchronous and asynchronous