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# Promoting reading comprehension with the use of technology

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ABSTRACT

The research presented here explores the impact of two web-based applications (an interactive, multimedia literacy software and a digital process portfolio) on early elementary students' reading comprehension. Two studies were conducted during the 2010–2011 and the 2011–2012 school years, targeting 26 teachers from elementary schools (grades 1–2), and their students ($N = 517$) from six English school boards in Quebec, Canada. Analyses of covariance showed that students using both tools performed significantly better ($p < .001$) compared to controls in reading and written expression as measured by standardized tests.



## 1. Introduction

Basic literacy is essential to a country's well-being, as measured by a variety of indicators, with literacy rates linked to school achievement (e.g., Cunningham & Stanovich, 1998), high school graduation rates (e.g., Hernandez, 2011), as well as a country's overall economic success (e.g., Kutner et al., 2007). Nevertheless international comparisons repeatedly reveal that after years of schooling a large number of children is not particularly good readers. In OECD (2010) countries about 19% of 15 year olds do not have sufficient reading skills to participate effectively in life.

At the same time, reading research accumulated in the past decades has pointed to what effective reading instruction entails. First, it should address key literacy components such as phonemic awareness, phonics, fluency, vocabulary, and comprehension (e.g., NRP, 2000). Second, it should provide a balanced combination of pedagogical strategies targeting lower-order (decoding for example) and higher-order (comprehension, meta-cognition) processes as well as offer extensive and diverse types of reading practices (guided reading, repeated reading) and writing activities (e.g., NRP, 2000; RAND Reading Study Group, 2002; Shanahan, 2006). Third, to help learners understand increasingly sophisticated material in all subject domains, reading comprehension instruction should start at an early age (e.g., Pressley & Gaskins, 2006). In fact, children need to develop literacy skills by grade 3 to avoid falling behind in school, a gap called the Matthew effect that grows over time. Finally, the research also shows that wise uses of appropriate learning technology applications can facilitate reading instruction (e.g., Cheung & Slavin, 2012).

While there is encouraging evidence that reading programs, both with and without the use of technology, promote aspects of reading acquisition such as alphabetics and phonics (e.g., Alvermann, Fitzgerald, & Simpson, 2006; NRP, 2000), less is known about ways to promote the development of comprehension skills. Therefore, the current study was designed to identify whether teacher integration of two compatible web-based applications into their English Language Arts curriculum would improve the comprehension skills of early elementary students. One of the tools, ABRACADABRA (ABRA) is an interactive multimedia tool that uses a balanced approach to develop emerging literacy. The second tool, ePEARL, is a digital portfolio that supports the processes of self-regulated learning. Evidence we have collected to date demonstrates the effectiveness of both tools. ABRA aids young students with letter-sound knowledge, phonological blending, listening comprehension and reading comprehension (Di Stasio, Savage, & Abrami, 2012; Savage, Abrami, Hipps, & Deault 2009;

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Savage et al., 2013). ABRA has shown positive results in different populations: children with poor attention (Deault, Savage, & Abrami, 2009), low socioeconomic pre-reading students in transition level classrooms and indigenous students in Australia (Wolgemuth et al, 2013) and Kenya (Abrami, Wade, Lysenko, Marsh, & Gioko, 2013). Studies examining the effectiveness of ePEARL for language instruction (Meyer, Abrami, Wade, Aslan, & Deault, 2010; Abrami, Venkatesh, Meyer, & Wade, in press) report that elementary students in classrooms where ePEARL was systematically used demonstrated significant learning gains in writing and major meta-cognitive skills including setting goals and identifying effective strategies for writing as compared to control students.

### 1.1. Reading comprehension and self-regulation

As they read, people must construct meaning from the written word; thus, comprehension is central to reading. The process of comprehending is developmental and multifaceted, involving the orchestration of multiple skills (RAND Reading Study Group, 2002). There is a wide consensus that in order to comprehend a text successfully students must be able to identify words effortlessly and simultaneously understand the words' meaning, suggesting that the link to comprehension goes from phonological processing through word identification to comprehension itself. Processes related to written word recognition, including accurate decoding, fluency and listening comprehension, are called upon by reading comprehension especially at the early elementary level (e.g., Verhoeven & van Leeuwe, 2008). Language development aspects including but not limited to vocabulary (e.g., Baumann, 2009), awareness of syntactic complexity (e.g., Scott, 2004) and semantic knowledge (e.g., Vellutino, Tunmer, Jaccard, & Chen, 2007) have also been proposed as important sources of reading comprehension. Research also points out that as young readers progress through their schooling it is the active use of higher-level strategies that predicts reading comprehension above and beyond word recognition and language ability. The strategies include knowledge of text structure and its features, inference making as an ability to discover the causal structure of a narrative text, and comprehension monitoring as a skill to verify understanding and make repairs (e.g., Cain, Oakhill, & Bryant, 2004). In addition, motivation to read has an important influence on the development of students' comprehension (Guthrie et al., 2007). Finally, current evidence in the field of literacy suggests the link between reading and writing. These two mutually reinforce each other as they rely on some of the same cognitive processes (e.g., Shanahan, 2006).

Highly praised as a central competence to initiate and support life-long learning (European Union Council, 2002), the self-regulated learning (SRL) framework also offers a theoretical basis for reading comprehension, emphasizing the interaction of higher-order processes working together during information processing. Defined as "self-generated thoughts, feelings and actions that are planned and cyclically adapted to the attainment of personal goals" (Zimmerman, 2000, p.14), SRL unfolds through three cyclical phases of forethought, performance, and self-reflection, in which students activate and sustain cognitions, behaviors, and affects that systematically orient them toward the attainment of learning goals (Zimmerman & Schunk, 2011). The model addresses both meta-cognitive and motivational aspects of learning. In the forethought phase, goal setting and strategic planning is affected by learners' self-motivation beliefs in the form of self-efficacy, outcome expectations, intrinsic interest or value, and goal orientation. In the performance phase, learners use self-instruction, attention focusing, task strategies, self-recording, and self-experimentation to yield vital information about how well they are progressing towards a goal. Finally, at the self-reflection phase, the processes of self-judgment and self-reaction are triggered as learners evaluate themselves relative to others, attribute their successes and failures, experience self-satisfaction, and activate adaptive–defensive responses to the achieved outcome. Constant monitoring and subsequent correction of one's own performance based on feedback about recent efforts enable the cyclical nature of the self-regulation process.

Existing empirical evidence demonstrates that self-regulation is linked to motivation (Pintrich, 2003) and learning achievement (e.g., Azevedo, 2005; Paris & Paris, 2001; Winne, 1995; Zimmerman, Bandura, & Martinez-Pons, 1992). Research also reveals that self-regulation interventions have been beneficial for reading comprehension in particular. These vary from single strategy programs such as generating questions to capture the main idea (Rosenshine, Meister, & Chapman, 1996), to various configurations of strategies such as Concept-Oriented Reading Instruction (Wigfield & Guthrie, 1997), to comprehensive instruction addressing cognitive, meta-cognitive, and motivational aspects of self-regulation (Souvignier & Mokhlesgerami, 2006). Recent findings also suggest that self-regulation can be taught effectively as early as primary school age or even earlier (e.g., Annevirta & Vauras, 2006; Whitebread et al., 2009). Dignath, Buettner and Langfeldt's (2008) meta-analysis of self-regulated learning intervention studies in a primary school context shows that for reading and writing outcomes, the average effect size for SRL programs was +0.44. Different configurations of instructional strategies also yielded high effect sizes for reading and writing performance. Specifically, the average effect size was +0.50 for meta-cognitive and cognitive strategy interventions, whereas it was +0.46 for programs combining cognitive and motivational strategies. Interestingly the instruction of cognitive strategies alone led to low effect sizes (+0.15).

### 1.2. Technology and reading comprehension

While teaching self-regulated learning strategies may improve reading comprehension, so too may the use of digital technologies have a positive effect on a reader's comprehension skills. In the past decades, researchers have systematically reviewed the impact of computer technologies on reading (e.g., Blok, Oostdam, Otter & Overmaat, 2002; Cheung & Slavin, 2012; Dynarski et al., 2007; Kulik & Kulik, 1991; NRP, 2000; Slavin, Lake, Chambers, Cheung & Davis, 2009). In general, their findings suggest the potential for technology to improve reading outcomes. In a review of reading programs for elementary students, Slavin et al. (2009) argue that, if woven into comprehensive literacy pedagogy, technology can maximize students' engagement by providing them with meta-cognitive strategies for text comprehension as well as strengthening other reading skills. Summarizing the research on effective uses of computers to teach reading comprehension, Kamil and Chou (2009) conclude that computer-assisted instruction holds promise for teaching comprehension skills ranging from word knowledge to strategies and meta-cognitive abilities. Boekaerts and Corno (2005) and Zimmerman and Tsikalas (2005) emphasize that computer-based learning environments provide scaffolds to assist students in controlling their learning and lead to greater autonomy.

Research also suggests that reading comprehension instruction delivered by computer technology may reduce the challenges that teachers face as they try to implement multiple, complex reading strategies in the classroom. van Keer (2004), Ness (2011) and Paris and Paris (2001) found that teachers tend to rely on single strategy comprehension instruction, ignoring the fact that an active reader must