

Improving Literacy Skills with ABRACADABRA

by Larysa Lysenko, Eugene Borokhovski, Philip C. Abrami, and Anne Wade

Research has made a persuasive case that by grade 3 it is essential for children to possess a set of strong reading skills to learn effectively in any subject area throughout their lives. Hence, early development of reading proficiency is a critical priority not only for closing the achievement gap and reducing dropout rates but eventually for cultivating the educated and skilled workforce needed for an effective economy. For instance, a 1% increase in the Canadian literacy rate would drive a sustainable growth in GDP (gross domestic product) of 1.5% per person or \$18.4 billion annually (Coulombe, Tremblay, & Marchand, 2004).

In its continuing effort to help students build strong reading skills and combat the high percentage of low ability readers, the Centre for the Study of Learning and Performance (CSLP) at Concordia University developed ABRACADABRA (A Balanced Reading Approach for Children And Designed to Achieve Best Results for All). ABRACADABRA, or as we call it, ABRA, is a free, interactive literacy software designed for early elementary school-aged children, their teachers, and parents.

The full version of ABRA that stores student records and provides access to the assessment and communication features is part of the Learning Toolkit that must be installed locally on a server at the school board (http://doe.concordia.ca/cslp/cslp_cms/ltk). The Learning Toolkit is a collection of web-based educational software, which also includes ePEARL, a digital portfolio to support student self-regulation, reading comprehension and writing skills, and ISIS-21, a tool to develop the student information literacy skills needed to find, retrieve, analyze, and use information. A limited version of ABRA is available on the Internet and can be accessed from <http://abralite.concordia.ca>

Features of ABRACADABRA

ABRA offers a balance between code-emphasis and a literature-rich context by means of instructional activities linked to interactive stories of various genres. This design provides a large selection of strategies that allow young readers the ability to pursue reading even when the meaning breaks down.

Student Module

ABRA's 21 interactive stories help students read independently. Readers can use the "birdie" icon to hear the text read aloud from the page on the screen or they can click on any word in the stories for help with sounding out and sight word reading. In addition to interactive stories, a total of 15 stories written by students are also available. These stories are recorded in Canadian, Australian, and Kenyan accents to expose students to a variety of pronunciations for their entertainment and education.

Targeting key literacy components, ABRA has alphabetic, fluency, comprehension, and writing activities at many different levels of difficulty and complexity. Each activity is preceded by a brief demo.



Figure 1. Access to ABRA stories and activities

Seventeen alphabetic activities reinforce students' abilities to associate sounds with letters and use these sounds to create words. To build the context necessary for practicing specific vocabulary and all reading related skills, the alphabetic activities are practiced within ABRA stories. Many activities are appropriate for students who are struggling or are at the beginning stages of alphabetic skills development. These activities mainly focus on listening skills, auditory discrimination, and letter naming. For those students who are ready for more advanced practice the activities include word family manipulation, decoding, and blending tasks with text support. In ABRA there are activities that are appropriate for all levels and provide practice such as Letter Bingo and Letter-Sound Search.

Five activities in ABRA allow for extensive practice in reading fluency and target all sub-skills including expression, speed, and accuracy. Good reading models are built into these activities so students can hear appropriate examples and evaluate if, how, or where they can improve.

ABRA has focused on developing skills that contribute to reading for meaning. Eight comprehension activities have various levels and range from simpler to more challenging tasks, such as placing the elements of a well-known story in order to summarize an entire text. Other activities allow students to respond to a question prompt, think critically about a text, and respond appropriately given the context of the story. Additional vocabulary activities help students build a bank of words that they can read (i.e., decode) but may not be able to understand.

Finally, writing activities in ABRA are designed for young readers to apply their literacy experiences to the writing of words and sentences. Scaffolds are built in so that students can complete the writing activities on their own. When words are spelled incorrectly, ABRA provides prompts to support and encourage students until the words are spelled properly.

Continued on page 12

To engage children in reading and writing and to increase their motivation, ABRA is designed as a game. In each ABRA activity, students are rewarded with a mini-game once they reach a goal by following a set of simple rules. Examples include being challenged to free a picture caught in seaweed before the time runs out, landing an ABRA character on a



Figure 2. A mini-game in ABRA

target with a parachute, protecting a whale from obstacles as they bring it to the ocean, or lighting up stars following the sequence they were shown. Sometimes games are at the core of the pedagogical structure of ABRA activities. For instance, in the Word Matching activity children have to find cards with similar sounds at the beginning or end of the words.

ABRA characters also add to the tool's game-like feel. Each character has a personal story that the children can read or listen to, while at the same time offering the context of what students have to do in each activity. These underlying narrative threads add to the gaming experience in ABRA.

ABRA offers a degree of autonomy to students as they can both choose a book of their liking or select an activity, as well as its level of difficulty. As students interact with the tool, ABRA embedded support tailors the degree of scaffolding they may require. If students answer incorrectly, they are provided with suggestions or can seek help.

ABRA also encourages collaborative work. While in ABRA, students can be joined by a classmate and do activities and read stories with them. Teachers, too, can pair up with their students to provide more individualized support and guidance.

Teacher Module

ABRA is a collection of rich pedagogical resources that teachers can use when, how, and with whom they see fit. The flexible and modular design of the ABRA software enables teachers to access and re-use the instructional components based on their teaching preferences and the needs of their students. Moreover, the tool is neither linear in use nor prescriptive of a single approach or method of teaching students

to read. Teachers can target specific skills for instruction as well as guide their class or individual students from basic sound and letter identification to complex tasks such as spelling, comprehension, and individual responses to various stories.

ABRA assessment features in the teacher module enable teachers to view student and whole-class performance on instructional activities by generating time-on-task and error reports for any period of time. Teachers see exactly what their students have done in ABRA and also get suggestions on how they can address their students' reading weaknesses.

Basic Decoding							
49 min.	3						
time spent	num. sessions						
Partners							
Lindsay Bernath, Vanitha Pillay, Benoit Danis, Erin Comaskey, Gia Deleveaux							
Stories							
The Little Red Hen, How a Bean Sprouts, Darryll Don't Dawdle							
Sound Identification							
	level 1	level 2	level 3	level 4	level 5	level 6	level 7
Correct	1			5	1		
Help					1		
error report							
Image Identification							
	level 1	level 2	level 3	level 4	level 5	level 6	level 7
Correct	1		3				
Incorrect			2	2			
error report							
Answer	Student Answer						
black	braid						
crop	spot						
test	river						
gold	shelf						

Figure 3. A sample ABRA assessment report

A rich collection of printable resource materials, video teaching vignettes, and ideas for lesson plans is available in ABRA to support teachers. In addition, the teacher module offers an online space for teachers and other professionals to exchange information about ways to promote student literacy. By joining ABRA wiki, teachers can download and upload lesson plans, access "hot-of-the-press" activity ideas, printable materials and rubrics, join and start stimulating discussion forums, collaborate quickly and easily on teaching practices, and more.

The effectiveness of ABRA as a tool depends on the teachers who use it. Indeed, for ABRA to have an impact, it requires good pedagogical use of the tool that cannot be reduced to sitting the children down in front of the computer and walking away. Optimal integration of ABRA in classroom instruction requires teachers' adherence to a balanced teaching of key literacy components based on differentiation and progression of instruction to meet students' learning needs. In addition, it requires a time commitment: each student should be exposed to ABRA instruction for about 2 hours per week for no less than 13 weeks.

Parent Module

With the idea of active support that parents can provide to their children's learning, the parents' module has been incorporated into the tool. This module provides step-by-step instruction on using ABRA at home, information about

emergent readers, and tips on raising a reader. For instance, a set of resources helps parents engage their children in phonemic awareness, reading, and spelling activities. Embedded videos show parents how to use ABRA outside of the classroom setting. Frequently asked questions and helpful tips offer additional support to extend literacy activities.

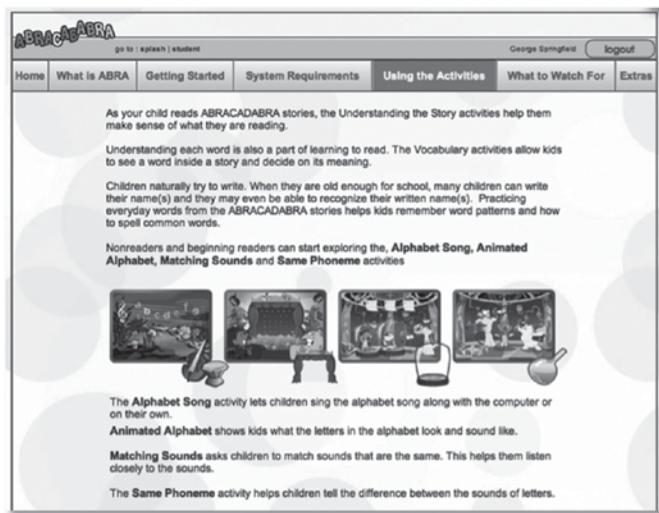


Figure 4. A parent module page

Summary of Research about ABRA

One of the basic principles underlying ABRA development and implementation is the tool's reliance on research evidence. Indeed, research is the foundation on which ABRA was designed and developed, including the recommendations from the National Reading Panel (2000) and other research in language and literacy. Available research on technology for learning also helped provide the foundation of ABRA. Not only does the tool try to make the most out of what works in early literacy education in general, its own success is a subject for verification through extensive trials of the effectiveness of ABRA implementations.

Throughout the years we have performed more than a dozen validation studies in Canada and internationally to explore the impact of ABRA on various facets of children's reading. Some of these are modest studies while others are large-scale and longitudinal investigations complete with random assignment of classes to ABRA and control groups. We have summarized the findings of the best seven ABRA studies conducted between 2008 and 2012 (Abrami et al., under review). From the total of about 2,400 students who participated in these seven studies, 1,264 elementary students were exposed to ABRA instruction. Students ranged from kindergarten to grade 3 with the majority in grades 1 and 2 as well as split 1-2 grade. Schools were from various geographical locations across Canada and internationally. Participating Canadian schools were mainly urban and suburban. Although the majority of schools were in Quebec, some were in Ontario and Alberta. Three international studies unfolded in provincial and remote schools in the Northern Territories of Australia and urban schools in Kenya.

To capture changes in students' reading skills in ABRA and control groups over time, a number of standardized tests of

achievement were used either partially or in full. For instance, Woodcock–Johnson III Tests of Achievement (Woodcock, McGrew, Mather, 2001) subscales of Word Attack and Reading Fluency measured the ability to assemble the pronunciation of a letter string by applying knowledge of typical correspondences between graphemes and sounds and reading speed. The Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999) subtest of Elision was used to assess the ability to say a word, repeat it after the examiner, and then say what is left after dropping out designated sounds. The Blending Words subtest of CTOPP targeted a student's ability to combine sounds to form words. Group Reading Assessment and Diagnostic Evaluation (GRADE; Williams, 2001) was used to measure a set of reading comprehension skills and comprised the subtests of Word Reading, Word Meaning, Sentence and Passage Comprehension, and Listening Comprehension.

The tests measured the development of skills related to key literacy components that include phonics, phonemic awareness, fluency, vocabulary, reading comprehension, and listening comprehension. Literature (for instance, NRP, 2000; Savage & Pompey, 2008) defines these components as follows:

- *phonics* – the ability to hear and manipulate individual sounds in spoken language;
- *phonemic awareness* – the ability to relate specific written letters (*graphemes*) to specific sounds (*phonemes*), to establish grapheme–phoneme correspondence;
- *fluency* – the ability to read text effortlessly and expressively;
- *vocabulary knowledge* – the ability to recognize the spoken and written forms of the word as well as its meaning;
- *reading comprehension* – the ability to understand and interpret printed text; and
- *listening comprehension* – the ability to understand and interpret text presented aurally.

In total in the seven studies, ABRA and control groups were compared 65 times on different reading outcomes. Phonemic awareness, phonics, and vocabulary were the skills with the highest number of comparisons (19, 17, and 14 times, respectively) whereas on fluency, reading, and listening comprehension outcomes, ABRA and control groups were compared 5 times.

We used *average effect sizes* (Hattie, 2009) as a simple way to quantify the difference between ABRA and control groups on the six reading-related skills. An effect size shows the magnitude of difference (standardized) between the two groups in students' reading gains or, in other words, the extent to which average students' reading improvement in ABRA classes would exceed that of students from non-ABRA control classes. The results of the comparisons show that the positive effects of ABRA hold for all types of reading skills and measures and range from small (+ 0.031 in vocabulary knowledge) to

Continued on page 14

moderate (+ 0.430 in listening comprehension). This finding implies that an average student exposed to ABRA for about two dozen hours performed at a higher level than an average student from the control group consistently on all reading-related skills. Not only that, all average effects were stable, that is, consistent across age groups and geographic locations.

A way to translate the magnitude of difference indicated by an effect size into the language of classroom practice is to convert it into an *average percentile gain*. The obtained effect sizes suggest how an average student with the score of 50 would increase his or her percentile scores after ABRA had been part of instruction. Specifically, the percentile scores would grow from 50 to 63 in phonemic awareness (effect size: +0.323), to 56 in phonics (effect size: +0.150), to 53 in fluency (effect size: +0.082) to 51 in vocabulary (effect size: +0.031), to 54 in reading comprehension (effect size: +0.087), and to 67 in listening comprehension (effect size: +0.430).

In summary, the results of the seven studies consistently demonstrate positive effects of ABRA on elementary students' reading skills. These effects are particularly noticeable in phonics, phonemic awareness, and listening comprehension. The findings of lower effects require some explanations that can be summed up as follows. Because of the modest number of comparisons between ABRA and control groups, we may have failed to find the high impact of ABRA on reading fluency and comprehension. Low sensitivity of standardized measures of vocabulary knowledge (NRP, 2000) might have resulted in an underestimation of ABRA effects. In addition, the results call for refinement and expansion of ABRA activities and also suggest that the way teachers integrate ABRA into their literacy instruction is critical to its success. In the next section we have consolidated what we have learned about implementation from these results.

ABRA Implementation Lessons

On the basis of studying ABRA use in classrooms over the years, we have also learned the following valuable lessons on how to implement ABRA that can be generalized to other educational contexts:

1. ABRA has been shown to be effective on a range of elementary school students' basic reading skills in a wide variety of instructional contexts using an array of standardized measures and research designs. Moreover, in many cases students only received ABRA instruction for about two hours per week for a few months. Nevertheless, even with only two dozen hours of exposure to ABRA, literacy gains were noticeable.
2. ABRA effects may vary as a function of student characteristics, including reading ability, attention, mother tongue, etc. These characteristics have not been accounted for in our synthesis of ABRA impacts as very few studies targeted them. For instance, one report suggests that ABRA supports students with attention difficulties (Deault, Savage, & Abrami, 2009) and in Australia ABRA benefited indigenous students more than their non-

indigenous peers on phonological awareness, phonics, and early literacy skills (Wolgemuth et al., 2011, 2013). ABRA also offered promise for reducing the difference between high- and low-ability readers. Kenyan students who scored poorly on the reading pre-test after ABRA instruction demonstrated significantly higher gains than students who were high performing on the pre-test (Abrami, Wade, Lysenko, Marsh, & Gioko, 2013).

3. Evidence shows that for reading comprehension instruction to be effective it should develop students' cognitive and metacognitive strategies. To support this finding, the combined use of ABRA with ePEARL, a digital portfolio that supports self-regulation processes, yielded significant improvements in student reading skills including vocabulary, reading comprehension, and written expression (Lysenko & Abrami, 2014).
4. Large ABRA impacts are attributable to high-quality implementation (Savage, Abrami, Hipps, & Deault, 2009; Savage et al., 2010; Wolgemuth et al., 2013; Savage et al., 2013). High quality implementation is defined as the systematic teaching of the key aspects of early literacy intervention in a balanced way and tailoring instruction to meet the learning needs of students. This approach requires teachers' technical competency, good lesson planning, clear instruction differentiation where systematic attention is given to decoding and text comprehension, and adequate time for student exposure to the software. Importantly, ABRA makes a difference when its underlying pedagogical approach becomes a coherent part of the language arts curriculum. In addition, pedagogical context in the classrooms should be student-centered, where students use ABRA in pairs and small groups—a strategy that has repeatedly proven effective (Hattie, 2009).
5. Although ABRA as an educational software may provide the means to scaffold teachers' and students' learning, the tool is not a sufficient condition for change in teaching practices. Teachers must believe that the change encouraged by the use of this tool is valued and necessary for meaningful learning. Teachers need to develop facility with the student-centered processes embedded in ABRA software and they should be supported in their learning with regular professional development time. It is important that teachers rely on the system embedded in ABRA, such as ABRA assessment reports as well as teacher resources designed to enhance classroom implementation. Additionally ABRA extension activities for literacy instruction, outside of ABRA-dedicated classroom time, may strengthen the effects of the software on the development of early reading skills.
6. ABRA produces effects in authentic contexts, where regular classroom teachers successfully integrate ABRA in their regular English language arts classrooms. Researchers' participation in this process can be reduced

to almost zero. Instead, the charge of pedagogical support can be fully carried out by school board consultants who by virtue of their position are responsible for teacher professional development.

- Offering an elaborate system of support to parents, ABRA encourages parental involvement in the process of their children learning to read. Research has shown that home literacy experiences have an important impact on early literacy development. Although parental involvement has not been specifically targeted by ABRA studies, anecdotal evidence from teachers, students, and parents shows that ABRA is a potentially powerful tool in the hands of parents.

Taken together, we have collected positive evidence of the overall value of ABRA as a tool to support early reading proficiency. We invite educational practitioners and parents to use ABRACADABRA, available without charge, so that together we can improve not only students' reading performance but also contribute to their lifelong learning success.

References

- Abrami, P. C., Borokhovski, E., & Lysenko, L. (under review). The effects of ABRACADABRA on reading outcomes: A meta-analysis of applied field research.
- *Abrami, P. C., Wade, C. A., Lysenko, L., Marsh, J., & Gioko, A. (2013). *A study of ABRACADABRA early literacy software in Mombasa, Kenya: Phase one report*. Centre for the Study of Learning and Performance: Montreal, QC. Web site: http://grover.concordia.ca/abracadabra/promo/en/download/Kenya_ReportPhaseOne20130607.pdf
- *Anderson, A., Wood, E., Piquette-Tomei, N., Savage, R., & Mueller, J. (2011). Evaluating teachers' support requests when just-in-time instructional support is provided to introduce a primary level web-based reading program. *Journal of Technology and Teacher Education*, 19, 499–525. Retrieved from <http://www.edlib.org/p/34599>
- *Comaskey, E., Savage, R., & Abrami, P. C. (2009). A randomized efficacy study of web-based synthetic and analytic programmes among disadvantaged urban kindergarten children. *Journal of Research in Reading*, 32(1), 92–108. Available from <http://dx.doi.org/10.1111/j.1467-9817.2008.01383.x>
- Coulombe, S., Tremblay, J. F., & Marchand, S. (2004). *Literacy scores, human capital, and growth across fourteen OECD countries* (Cat. 89-552-MIE, no. 11), Statistics Canada.
- *Deault, L., Savage, R., & Abrami, P. C. (2009). Inattention and response to the ABRACADABRA web-based literacy intervention. *Journal of Research on Educational Effectiveness*, 2, 250–286. Available from <http://dx.doi.org/10.1080/19345740902979371>
- Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. London, England; New York, New York: Routledge.
- Lysenko, L. V., & Abrami, P. C. (2014). Promoting reading comprehension with the use of technology. *Computers & Education*. Advance online publication. Available from <http://dx.doi.org/10.1016/j.compedu.2014.01.010>
- National Reading Panel (NRP). (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction* (NIH Pub. No. 00-4754). Retrieved from National Institute of Child Health & Human Development website: <http://www.nichd.nih.gov/publications/pubs/nrp/pages/report.aspx>
- *Savage, R. S., Abrami, P., Hipps, G., & Deault, L. (2009). A randomized controlled trial study of the ABRACADABRA reading intervention program in grade 1. *Journal of Educational Psychology*, 101(3), 590–604. Available from <http://dx.doi.org/10.1037/a0014700>
- *Savage, R., Abrami, P. C., Piquette-Tomei, N., Wood, E., Deleveau, G., Sanghera-Sidhu, B., & Burgos, G. (2013). A (pan-Canadian) cluster randomised control effectiveness trial of the ABRACADABRA web-based literacy program. *Journal of Educational Psychology*, 105(2), 310–328. Available from <http://dx.doi.org/10.1037/a0031025>

- *Savage, R. S., Erten, O., Abrami, P. C., Hipps, G., Comaskey, E., & van Lierop, D. (2010). ABRACADABRA in the hands of teachers: The Effectiveness of a web-based literacy intervention in grade 1 language arts programs. *Computers in Education*, 55, 911–922. Available from <http://dx.doi.org/10.1016/j.compedu.2010.04.002>
- Savage, R. S., & Pompey, Y. (2008). What does the evidence really say about effective literacy teaching? *Educational and Child Psychology*, 25, 21–30.
- Wagner, R. K., Torgesen, J. K., & Rashotte, C. A. (1999). *The Comprehensive Test of Phonological Processing (CTOPP)*. Austin, TX: Pro-Ed.
- Williams, K. T. (2001). *Group Reading Assessment and Diagnostic Evaluation (GRADE)*. Circle Pines, MN: American Guidance Service (AGS, Inc.).
- *Wolgemuth, J., Savage, R., Helmer, J., Bottrell, C., Lea, T., Harper, H., . . . Abrami, P. (2011). Using computer-based instruction to improve indigenous early literacy in Northern Australia: A quasi-experimental study. *Australasian Journal of Educational Technology*, 27, 727–750. Retrieved from: <http://www.ascilite.org.au/ajet/ajet27/wolgemuth.html>
- *Wolgemuth, J., Savage, R., Helmer, J., Harper, H., Lea, T., Abrami, P. C., . . . Loudon, W. (2013). ABRACADABRA aids indigenous and non-indigenous early literacy in Australia: Evidence from a multisite randomized controlled trial. *Computers & Education*, 67, 250–264. Available from <http://dx.doi.org/10.1016/j.compedu.2013.04.002>
- Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock Johnson III Tests of Achievement*. Rolling Meadows, IL: Riverside.

Larysa Lysenko, Ph.D., is a researcher and the Research Coordinator at the Centre for the Study of Learning and Performance at Concordia University. Her interests include educational technology to enhance teaching and learning and evidence-based practices in education.

Eugene Borokhovski, Ph.D., is the Systematic Reviews Manager for the Centre for the Study of Learning and Performance at Concordia University. His areas of expertise and research interests include cognitive and educational psychology, language acquisition, and methodology and practices of systematic reviews (meta-analysis, in particular) in social sciences.

Philip C. Abrami, Ph.D., is a Concordia University Research Chair, the Director of the Centre for the Study of Learning and Performance, and a Professor of Educational Technology. His current work focuses on research integrations and primary investigations in support of applications of educational technology in distance and higher education, in early literacy, and in the development of higher order thinking skills. Among his numerous awards and distinctions, in 2010 he received the Canadian Education Association (CEA), Whitworth Award for Education Research.

Anne Wade, M.L.I.S., has been a Manager and Information Specialist at the Centre for the Study of Learning and Performance at Concordia University for 25 years. She has also been a sessional lecturer in the Department of Education for the past two decades and teaches Introductory Information Literacy Skills to undergraduates, now offered online. She is the former President of the Quebec Library Association and of the Eastern Canada Chapter of the Special Libraries Association.

References marked with asterisks (*) are reports of the studies used in the summary of ABRA research.