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"Lecture" with Interaction in an Adult Science Methods Course-Session: Designing Interactive Whiteboard and Response System Experiences

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Abstract

The current article addresses adult learning theory synthesized with higher educator use of interactive graphical interface, via the interactive whiteboard (IWB) and interactive response system, to provide an educational design framework for moving the traditional direct instruction "lecture" cognitively and kinesthetically to an interactive inquiry-based experience. To off-set retention of information issues experienced in lecture format/direct instruction presentations and the typical absence of immediate application of skills and content addressed, the authors designed an interactive science methods presentation with IWB software for instruction within a science teaching methods course for undergraduate students. Educational design principles are addressed for creating the interactive presentation and a visual portrayal of the IWB slides are included. Challenges and questions for further consideration are identified.

Introduction

Higher education or Teacher education faculty have wrestled with the problem of facilitating understanding of course content for large groups of students to the degree that they can transfer the content addressed. Despite the fact that most preservice teachers can be defined as digital natives (Prensky, 2001), Kleiner, Thomas, and Lewis discovered that most teacher education programs do not adequately prepare teachers to infuse technology into their classrooms upon graduation. Prior to prompting students to apply content, educators must consider ways to enhance content presentations, or lectures, to include: active learning (Brookfield & Preskill, 2005; Hinde & Kovac, 2001; Ebert-May & Allred, 1977; Williams, 2008); interactive components requiring collaboration (Sutcliffe, Codgell, Hansel & McAteer, 1999); and problem solving opportunities (Browne & Blackburn, 1999). Science methods courses in teacher education contain the dual challenge of facilitating content-area information that is then applied to inquiry-based teaching strategies for K-12 students. The current paper addresses an educational design framework, "Lecture with Interaction" that contains direct instruction components for the distribution of key course-session science content but weaves collaboration, problem-solving and interactivity into the experience using presentations authored with SmartNotebook software for the Interactive Whiteboard.

A "New" Literacy with a New Technology

While many educators have focused on IWB technology merely for the "bells and whistles" so inherently attractive to so many, we have leveraged a literacy strategy derived from writer's workshop (Graves, 1983) called "mini-lesson." Writer's workshop as Graves defined it provides teachers with a framework for facilitating student writing in a recursive (or cyclical) and discrete manner (specific stages of writing are: brainstorming, drafting, revising, editing and publishing). According to Graves the mini-lesson is used by the teacher to address student needs as they occur in the writing workshop in any stage of writing. For example, a mini-lesson topic might be "how have you developed sub-plots from your major plot"? The mini-lesson is fluid in that the teacher and students can identify problems, define them, discuss and then put new understandings in the next round of writing. In our sensibility, we have taken the notion of the mini-lesson and applied to an undergraduate science methods course session where students are assigned an activity, experience an IWB presentation/discussion structured by the professor in the same manner that a mini-lesson would be fashioned in a writer's workshop. What misconceptions might students have related to the science activity? What content can we present and interact around to address those misconceptions? The mini-lesson strategy functions to

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anchor and focus our use of the motivational and attractive technological features of IWB in a way that points us to dynamic interactivity and discussion of content.

IWB Software and Hardware Description

Similar to PowerPoint, IWB software supports presentation authoring with all of the typical tools available in most software products. For the current article, the authors used SmartNotebook v. 10 presentation software for the IWB but there are a plethora of similar and competing products that would suffice (http://www.fsdb.k12.fl.us/rmc/tutorials/whiteboards.html#brands). The main distinction between IWB authoring software and other presentation software is that the IWB software contains tools allowing you to easily program interactivity. Students then can literally get out of their seats, approach the IWB at the front of the room and click and drag items on the board and/or click items that play audio, video or other types of files. This would take the place of raising your hand to speak as now the student raises their hand, speaks, and physically demonstrates a point by placing an item/s in a two-dimensional location. This interactivity can also involve a small-group manipulating the IWB in front of the large group thus empowering the individual or small-group with an audience for demonstrating their thinking.

An IWB is an interactive display roughly 3 x 5 feet that connects to a computer and LCD projector. Similar to a regular LCD project the IWB projector beams the computer's desktop onto the board's surface and supports user control of the computer using a pen, finger or other device by touching the IWB and not the computer. The board is typically mounted to a wall or on a floor stand in the same general location that a chalkboard or chart paper stand would be (see Figure 1. Interactive whiteboard).

Figure 1. Interactive whiteboard.

Note: Projector location can vary from wall to ceiling mounts.

Smith, Higgins, Wall and Miller (2005), in their meta-analysis of IWB use in educational settings, signaled the need for establishing a consensus on effective teaching and learning prior to a focus on leveraging the bells and whistles of the technology. Given this sentiment, the authors created a presentation incorporating collaborative, active and problem-solving components to teach the science content of the water cycle in a teacher science education course. The interactive presentation, in juxtaposition to the traditional lecture, thus included supporting a large group of students in their interaction within the presentation as if it were a more intimate and collaborative setting.

An additional component supported by IWB is the Interactive Response System (IRS) that consists of remote control units for all students. Guthrie and Carlin (2004) found that use of

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IRS can increase motivation during those moments when passivity can set in during direction instruction by the professor. The IWB author can build in response prompts, essentially seeking whole-group reactions, that ask the respondent to vote in response to a question placed on the board. Instantaneously the IRS tabulates student responses and visually portrays the summary of responses on the IWB. IRS use can incorporate collaboration provided that questions to the whole-group are preceded with prompts such as "prior to answering this question, discuss with your small group what your current thinking is." IRS can also be used by the professor to conduct quick assessment checks either as an initial exercise to better inform the rest of the course session or as closure to ascertain effectiveness of instruction.

Course Session Student Characteristics: Pre-Service Teachers

The students in this course session consisted of teacher education majors, referred to as "teacher candidates" or "pre-service teachers." Many preservice teachers are what Prensky (2001) defines as digital natives. That is, they grew up "surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age" (p. 1). These students need to be taught how to integrate the multiple literacies with which they are so familiar into their own teaching to better address the students whom they will teach. Research (Eakle & Alvermann, 2006 as cited in Alverman & McLean, 2009; Hague & Mason, 1986; Hull & Zacher, 2004; Prensky, 2001; Tierney, Bond, & Bresler, 2006) documents that when students are involved in using out-of-school literacies that use digital media, they are more engaged in the learning process. Too often in-school literacy tasks do not mirror the ways that students use literacy in their everyday lives (Dunston & Gambrell, 2009). When allowed to use these multiliteracies, a term coined by the New London Group (as cited in Sylvester &

Greenidge, 2009), in school and university settings, students can find new "respect for classmates and their opinions, understanding work team dynamics, and using them for high-quality outcomes, taking turns, recognizing the different learning that can occur in the collaborative and cooperative context" (Afflerbach, 2007, p. 170). In addition, the Partnership for 21st Century Skills (2003) identified learning skills relevant for students who will job-search with individuals in a highly competitive global society, or flattened world as described by Freidman (2005). The Partnership described three discrete categories of skills: information and communication skills, thinking and problem-solving skills, and interpersonal and self-directional skills. For future teachers and students to be successful, Pensky (2001) offers powerful advice in his statement—"we need to invent Digital Native methodologies for *all* subjects, at *all* levels, using our students to guide us" (p. 6). The IWB Interactive Lecture model provides teacher preparation educators with methodology for developing content knowledge and pedagogical knowledge, as well as provides pre-service teachers with content knowledge and pedagogy.

Designing Interactivity for Content "Presentations" (or Interactions)

The authors designed a "presentation" with interactivity (see Hake, 1998) addressing water cycle science content prior to having students conduct an inquiry-based scientific experiment to facilitate their content-area knowledge within an inquiry-based learning paradigm (See Figure 1.2. IWB Sample Screen with Explanations). To "practice what we preach" we transformed the lecture-presentation into an intimate discussion involving individual, small-group and whole group exchanges of information, movement (student manipulation of concept facts on the IWB) and discussion. To align our need for increasing our students' science content knowledge in a "presentation" we thus mirrored inquiry-based science tenets summarized by Thier (2000):

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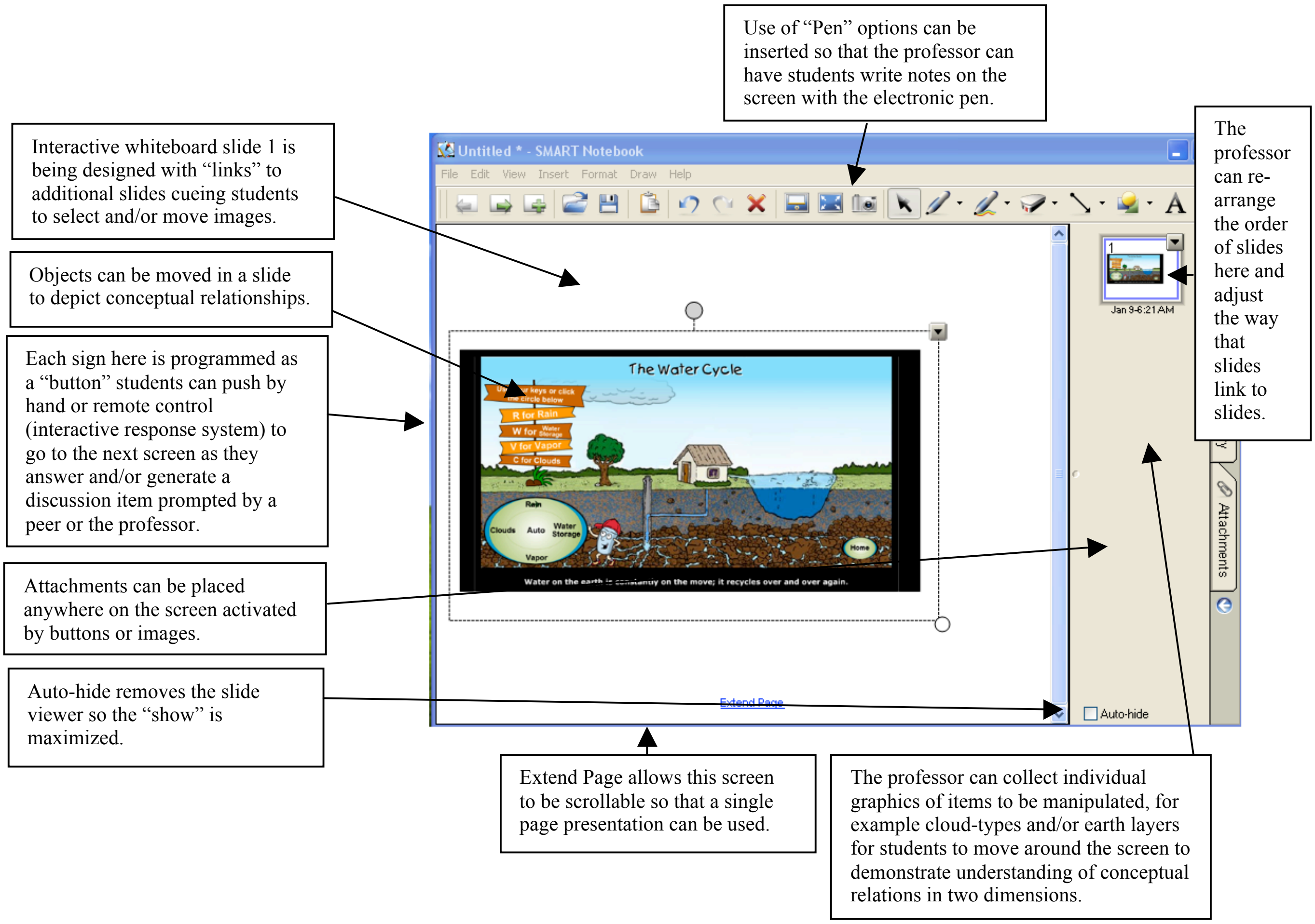
- Introduce content with open-ended questions and/or demonstration as opposed to listing definitions and explanations;
- solicit responses and subsequent questions from students.

In addition to the IWB experience we transitioned to conducting a water cycle experiment to follow-up on our initial discussion and this experience included additional elements recommended by Thier:

- have students conduct experiments following the scientific process involving hypothesizing, data collection and analyses;
- conclude with a re-evaluation of information addressed during the presentation of the water cycle science content;
- and have students present findings as an oral presentation or write-up (in our case we could have them express their result with IWB authoring.

Figure 1.2. IWB Sample Screen with Explanations.

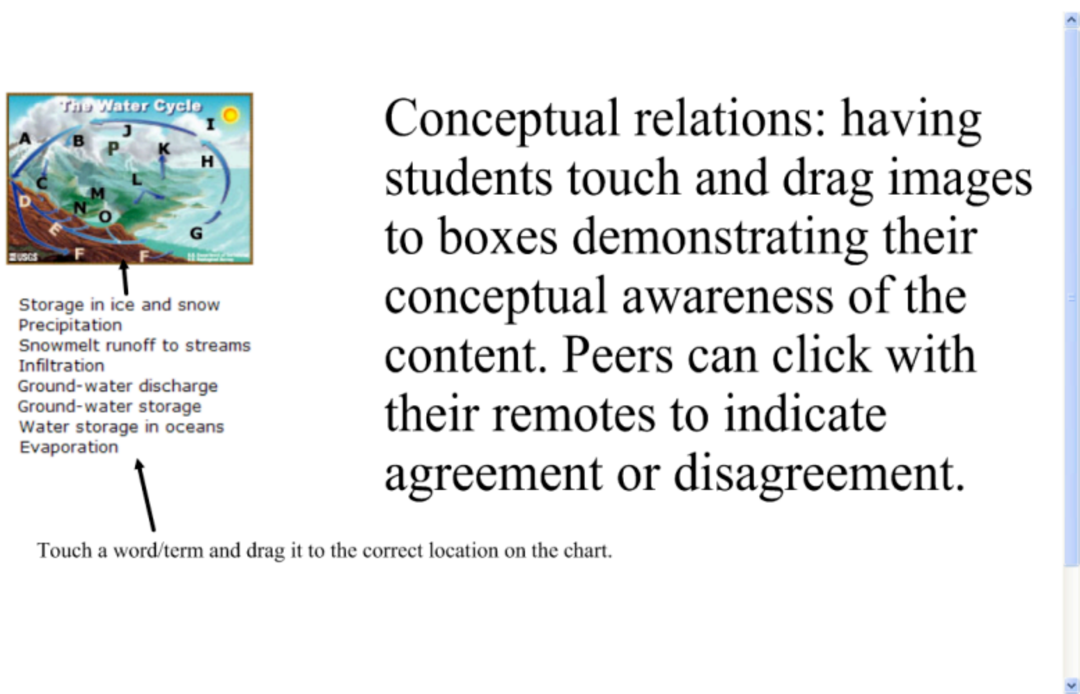


Note: Screenshot of software with Environmental Protection Agency public domain image inserted for Interactive Whiteboard experience.

A Science Education Higher Learning Course Session: Use of IWB

For the current course session the objectives were to facilitate adult students' understanding of the science of the water cycle system and processes and to learn how K-12 students might respond while conducting a hands-on experiment. The first part of the session consisted of a hands-on activity followed by the IWB presentation. An interactive presentation was designed for the IWB consisting of public domain images from the United States Geologic Society. On the IWB we placed an empty chart illustrating water cycle elements and then included a list that corresponds to certain illustration elements. For example "Precipitation" would need to be touched by a student and dragged the appropriate area of the illustration. Students could hypothesize where a word or term fits on the illustration and then the group discusses the merits of the "idea." Another student might move the word "Precipitation" to another area of the illustration presenting a new viewpoint. The professor can step in it time to transition to the next set of concepts and either provide the correct answer or allow them to continue with misconceptions until the students have more information from which to generate understandings that replace the misconceptions. (See Figure 1.3. Conceptual Relations-Connecting Water Cycle Elements with Descriptions).

Figure 1.3. Conceptual Relations-Connecting Water Cycle Elements with Descriptions.



Note: Images from public domain sites such as the U.S. Geologic Society are recommended (http://ga.water.usgs.gov/edu/watercyclerunoff.html).

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Teacher Education Students' Apply Content Knowledge in Hands-on Experiment

Science education methods coursework usually include extensive opportunities to conduct experiments across many branches of science and for this session students experienced a hands-on experiment suitable for their future K-12 students. See Figure 1.4 (Water Cycle Activity Teacher Education Students Learn to Teach) and Figure 2 (Condensation IWB Post Activity).

After conducting the experiment an extension to this course session might include the requirement that the teacher education students author an IWB presentation for K-12 students using similar design principals discussed above. The high prevalence of IWB systems in K-12 schools dictates that future teachers learn educationally sound ways to use the technology in their teaching and to think of how student-generated work might take advantage of the technology.

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Figure 1.4. Water Cycle Activity Teacher Education Students Learn to Teach

Materials

1) Two pieces 5 by 10 cm pieces aluminum foil
2) One clothes pin
3) Cube of ice
4) Small amount of water
5) One candle
6) One match

Procedures

1) Place cube of ice in one of the aluminum boats
2) Place 10 ml of water in one of the aluminum boats
3) Light candle and support on table upright
4) Hold aluminum boat that has water with a clothes pin just above candle flame
5) Hold aluminum boat with ice cube directly above aluminum boat with water approximately 2 centimeters.
6) Observe bottom of boat with ice cube and inside of aluminum boat with water
7) Record observations on back of page

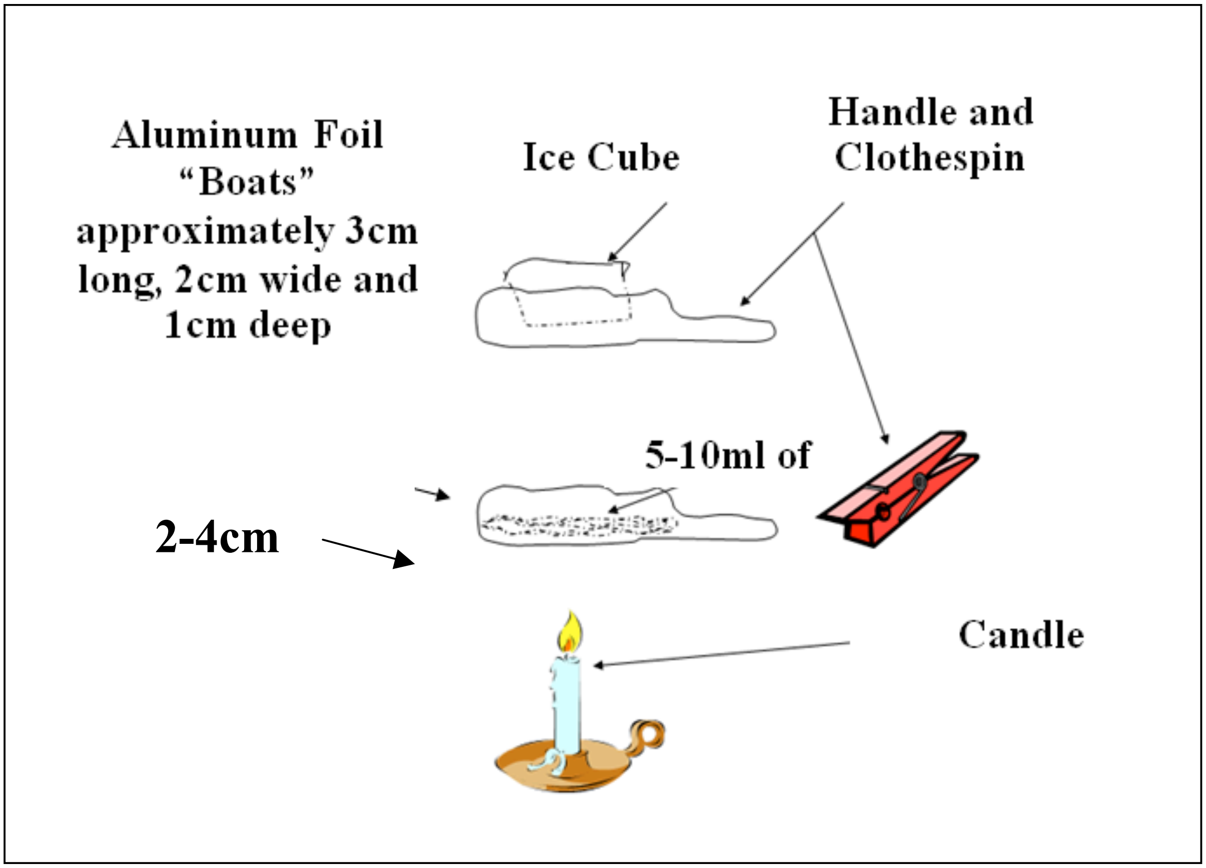
Question

1) What water cycle concepts are you observing?
2) As a group develop a possible explanation for your observations
3) What does this activity parallel to in nature?
4) Where is the water on the bottom of the foil coming from?

Reflection Type Individual Questions

1) How was math used in this activity?
2) What NSE standard and grade level would this activity match?
3) Is this a practical activity for the grade level you teach if not why?

Figure 2. Condensation IWB Post Activity.



Note: The IWB post activity depicted here represents an opportunity for the instructor to have students move the above pictures to their corresponding images (not shown) such as the candle would be moved next to the sun in the illustration of the water cycle. This follows inquiry-based learning (IBL) espoused by science educators. The expectation is that students first experiment to experience the phenomena with the materials and then conceptualize with their newfound knowledge gleaned from the experiment.

Conclusions

Teacher preparation faculty or higher education faculty who teach adult learners can leverage IWB and IRS technology in many ways to increase student motivation, interest and participation-all functioning to make the traditional direct instruction "lecture" more interactive. In the case of this article, an inquiry-based science methods experience was preceded by the IWB presentation to build students content knowledge without lecture. The mere expectation of having students move up to the front of the group to express their ideas by manipulating images and words on the IWB move students from passive listeners to active participators. Incorporating the IRS to assess student understanding instantaneously is also a powerful teaching and assessment tool. Students' misconceptions about the water cycle could be resolved either in the interactive presentation or during the hands-on science experiment follow-up activity. Clearly, there are numerous ways to use IWB and as educators of teacher education students, who advocate inquiry-based learning, we set out to resolve issues faced by educators during whole-group presentations. We recommend that researchers evaluate various educational design concepts to inform educators of key principles they must follow to take advantage of the tools.

The success of integrating the IWB/lecture in a method's course has the researchers currently involved in developing research strategies that measure achievement increases using IWB over more "traditional" presentational (e.g., Power Point) software uses. Currently, anecdotal data is the only evidence researchers have attained to attest to the effectiveness of incorporating IWB into a science methods course. Both quantitative and qualitative strategies are being considered by the researchers for future implementation and analysis. Specifically, a quasi-experimental study where achievement levels between a control group using traditional presentational software and a IWB treatment group is being considered. Furthermore, a longitudinal based study to determine if IWB skills picked-up in a methods course is transferred and continually used over time in a k-12 classroom is being proposed.

Funding for the development, implementation and field testing of a curricula that focuses on using IWB in multiple content areas is currently being sought. Upon completion of the curricula, researchers want to disseminate IWB uses and success stories through the development of a web site and curricula booklet. Furthermore, additional dissemination at professional

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conferences in the content areas where IWB use has been deemed a success is being proposed. Organizations such as the National Science Teachers Association for curricula dissemination and the National Association for Research in Science Teaching for research findings are subject specific areas for proposed dissemination. The International Society for Technology in Education through conference and/or book development is another logical avenue for dissemination of an IWB based curricula.

Key Design Principles for Educators

The following design principles were applied in this teaching case description and recommended for educators as they not only use IWB but author presentations involving interactivity:

1. Infuse combinations of text and graphics that are programmed to be manipulated in two dimensions (e.g. in Figure 1.3 students had to touch, drag and place water cycle concept facts on the water cycle illustration to demonstrate concept).
2. Organize cooperative groups (3-4) to discuss their ideas prior to prompting them to depict their understanding to the whole group when they manipulate the IWB presentation.
3. Leave questions open and unanswered, to instill an inquiry-guided experience (in the current case, we had the students conduct an experiment with water condensation to further investigate concepts related to understanding the water cycle).
4. Foster the disposition in students of accepting multiple viewpoints as “ideas” are manipulated in two dimensions on the IWB.

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5. Lastly, empower learners with assignments involving them to author their own interactive IWB presentations-they too can avoid being the "sage on the stage" during their presentations.

Design notes for inquiry-based learning (IBL) espoused by *science educators*:

1. Student exploration, in the form of conducting experiments, precedes the IWB demonstration to provide them the opportunity to learn phenomena associated with the scientific method.
2. Thus, the introductory presentation would not take place when strictly applying IBL.
3. Student-generated IWB presentations, following experiments, would demonstrate understandings and even guide the instructor in developing extensions or enrichment activities.
4. See the "5E" IBL model for further reading: http://faculty.mwsu.edu/west/maryann.coe/coe/inquire/inquiry.htm

Resources for Educators Learning IWB

Interactive Whiteboard Tutorials (K-12 but applications for higher education as well)-

http://www.fsdb.k12.fl.us/rmc/tutorials/whiteboards.html

http://www.waukesha.k12.wi.us/WIT/SmartBoard/specificapps.htm

IWB Flash Examples-

http://www.amblesideprimary.com/ambleweb/mentalmaths/protractor.html

http://teams.lacoe.edu/documentation/classrooms/amy/geometry/6-8/activities/quad_quest/quad_quest.html

Interactive Whiteboard Tools-http://www.shambles.net/pages/staff/intwhiteb/

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Using Electronic Books in the Classroom to Enhance Emergent Literacy Skills in Young Children

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Abstract

Electronic books (e-storybooks) are widely used in early childhood classrooms in efforts to encourage engagement in storybooks while promoting emergent literacy development. This article assesses the current research on e-storybooks for supporting young children and offers suggestions about how this evidence can be translated into best practice in the classroom. Findings suggest that the use of high quality interactive e-storybooks may support emergent literacy development through the use of scaffolding, thus, supporting vocabulary development, engagement, and comprehension of the story. Evidence suggests that lower quality e-storybooks may offer distracting digital features including animations and sounds unrelated to the story. Additional information about effective implementation in the classroom is provided.

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The use of e-storybooks in early childhood classrooms seems to be a growing trend. Educators are interested in the use of reading technologies to support young emergent readers, especially those who are at risk for reading failure. E-storybooks allow children to read and listen to a book while obtaining emergent literacy supports including digital features (e.g., animations, word pronunciations, etc.). Many of these books are commercially available to educators and parents and they allow children opportunities to read independently, even when they lack foundational reading skills. Despite the growing popularity of e-storybooks, there continues to be a lack of literature to explain the extent to which e-storybooks support children's emergent literacy development. This article examines current research on e-storybooks and provides suggestions about how educators can use critical evidence to better support young struggling readers in early childhood classrooms when using e-storybooks.

Early education experiences can provide children with opportunities to develop essential foundational skills in literacy that directly translate into later school success (Burchinal, Peisner-Feinburg, Pianta, & Howes, 2002; McCardle, Scarborough, & Catts, 2001). In the area of early literacy, intervention is cost effective and can improve the future academic achievement of children who are at-risk for academic failure (Ramey & Campbell, 1991; Schweinhart, Barnes, & Weikart, 1993). If children are unable to gain needed skills prior to beginning school, additional and more in-depth services may be required over time (Barnett, 1998).

Stanovich's work (1986, 1993) recognizes the strong relationship between early deficits in literacy skills and later risks for reading difficulties. The progressive widening of the gap between readers and non-readers is labeled as the Matthew Effect (Stanovich, 1986), a principle that emphasizes the importance of early interventions delivered to young children that seek to reduce this gap in its earliest manifestations. This empirical evidence combined with government

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reports (e.g., National Reading Panel; NRP, 2000) encouraged politicians to create legislation requiring the use of high-quality, scientifically-based instruction to increase children's academic achievements in reading if they are at risk (NCLB, 2001). Examinations surrounding best practices for early detection and intervention in the area of reading are therefore growing (Adams, 1990; Snow et al., 1998; Torgesen & Burgess, 1998) and a growing body of work in this area emphasizes the use of technology for improving children's emergent literacy skills. Thus, educators are working to provide high-quality evidence-based emergent literacy instruction during the critical developmental time period of early childhood, especially for children who are most at risk due to poverty and disabilities (Barnett, Brown, & Shore, 2004).

Emergent Literacy Development

The No Child Left Behind Act of 2001 specifies four areas of emergent literacy development children require before learning to read (Justice, Chow, Capellini, & Flanigan, 2003), and include (a) oral language, (b) phonological awareness, (c) print awareness, and (d) alphabet knowledge. Thus, instruction in these four areas is essential for young children at risk for reading difficulties. Oral language includes grammar, phonology, vocabulary, and pragmatics. Research indicates that 78% of oral language development is unexplained by age (Bates, Dale, & Thal, 1995). Thus, early education programs can provide children with opportunities to strengthen their oral language skills. Phonological awareness refers to the understanding of how speech can be broken down into smaller units of sound (Stanovich, 1991). Poor phonological awareness skills serve as a strong predictor of future reading difficulties in students (Cunningham, 1989). However, research indicates a mean effect size of .53 for the effectiveness of phonological awareness instruction for improving children's reading outcomes.

Thus, explicit instruction of phonological skills is essential (Ehri, 1989). Print awareness is knowledge of the form and function of print and the association between written and oral language units (Ehri, 1989; Ehri & Sweet, 1991; Snow et al., 1998). Acquisition of print concepts during the preschool years enhances a child's ability to bridge the gap between written and oral language (Adams, 1990). The implementation of these print referencing strategies may improve early achievements in print concepts (Justice & Ezell, 2002). Finally, alphabet knowledge refers to a child's ability to distinguish letters as separate units called graphemes and then name those letters (Worden & Boettcher, 1990). Letter identification is considered a predictor of letter sound knowledge, which is essential in achieving understanding of the alphabet principle and later decoding words (Ehri & Sweet, 1991). These concepts can be targeted through interactional storybook readings (Justice & Ezell, 2002). All these skills can be targeted through the use of shared storybook reading.

Shared Storybook Reading

A highly researched activity for promoting emergent literacy development is storybook reading because of its association with emergent literacy and oral language development (Bus, Belsky, van IJzendoorn, & Crnic, 1997; Bus, van IJzendoorn, & Pellegrini, 1995; Morrow, 1990; Scarborough & Dobrich, 1994). Immediate and lasting literacy and language achievements are associated with children's book-reading experiences (See Scarborough & Dobrich, 1994; Bus et al., 1995). More specifically, early book reading affects children's language (Conti-Ramsden, Hutcheson, & Grove, 1995; McCabe & Meller, 2004; Vallance & Wintre, 1997; van IJzendoorn, Dijkstra, & Bus, 1995), and literacy skills (Bus & van IJzendoorn, 1988; Reese & Cox, 1999). Another study by Gunn, Simmons, & Kame'enui, (1995) indicates that the following

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instructional interventions can promote emergent literacy development: (a) exposure to print through reading and writing, (b) opportunities to learn and use language, (c) letter instruction, and (d) phonological awareness instruction. Significantly, all of these intervention approaches can be readily integrated into a storybook reading context making e-storybooks a possible resource for young children. E-storybooks provide scaffolding which supports young children who are developing emergent literacy skills. For example, the computer reads and highlighting the text to support print awareness; provides animations to support comprehension; and uses graphics to engage the young reader.

Researchers are currently conducting investigations into whether e-storybooks can produce similar benefits to traditional print storybooks. Further, researchers are working to determine the extent to which e-storybooks can contribute to the improvement of children's language and literacy outcomes.

Potential Benefits of E-storybooks in the Classroom

E-storybooks are one form of technology that allow young children and struggling readers to enjoy books independently due to electronic features. Thus, it is possible that additional opportunities to explore e-storybooks may actually assist with the development of important emergent literacy skills. Electronic books are defined as an electronic form of a book with features similar to those of a traditional print book including pages that "turn," and digital features that can assist the reader such as word pronunciations, text highlighting, and text-to-speech options, and hypermedia (e.g., video, animations, and sound) (Horney & Anderson-Inman, 1999; Korat & Shamir, 2004). E-storybooks are widely used with students who are beginning to learn to read or diagnosed with reading disabilities (Zucker, Moody, & McKenna,

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2009). They can provide supports to include the use of digital scaffolding supports (McKenna, Reinking, Labbo, & Kieffer, 1999), pictures cues and read aloud options to enhance comprehension (Doty, Popplewell, & Byers, 2001; Greenlee-Moore & Smith, 1996; Matthew 1996; 1997), and word pronunciation tools to assist students with phonological awareness and decoding of text (Olson & Wise, 1992; Wise et al., 1989). For the purposes of this discussion two perspectives on e-storybooks will be discussed.

Two theoretical perspectives provide momentum for studies concerning the use of technology to support children's emergent literacy development, particularly the use of e-storybooks. More specifically, e-storybooks may support: (1) reading engagement, and (2) scaffolding for emergent literacy development during storybook reading activities. E-storybooks offer an engaging medium for young struggling readers, ease of implementation for classroom teachers, and opportunities for individualized practice for all students. Thus, young children who would not ordinarily be able to read a book on their own, (e.g., English Language Learners (ELL), children with disabilities, etc.), can independently explore text. Digital scaffolds are also available in e-storybooks to assist beginning readers who are learning to decode (McKenna et al., 1999). Theories of reading development recommend scaffolding to promote literacy development (e.g., Chall, 1996; Ehri, 1995).

Reading Engagement

Reading engagement is a mechanism for improving children's emergent literacy outcomes during shared-reading interactions is indicated by studies of storybook reading interactions showing that children's development is directly influenced by the types of tasks (e.g., use of a manipulative storybook; see Kaderavek & Justice, 2005), materials (e.g., use of

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manipulative figures; see Wasik & Bond, 2001), and verbal scaffolding and feedback children are provided when reading storybooks (see Whitehurst et al., 1988). These storybook reading activities promote active engagement and focus children on the storybook content (Whitehurst et al., 1988). Researchers are making efforts to identify storybook reading practices that modify the task, materials, and types of scaffolding adults can provide to increase reading engagement in young children (e.g., Justice & Kaderavek, 2002; Lonigan et al., 1999; Lonigan & Whitehurst, 1998; Wasik & Bond, 2001; Whitehurst et al., 1994). E-storybooks may offer increased interactive opportunities to promote child engagement, thus increasing child outcomes (de Jong & Bus, 2002, 2003; Fisch et al., 2002; Talley, Lancy, & Lee, 1997) (see Table 1).

Table 1

Digital Features Designed to Provide Evidence-Based Instruction

Emergent Literacy Skill	Digital Feature	Evidence-Based Instructional Technique
Alphabet Knowledge	Computers offers letter pronunciation	Adult names letters
	Computer highlights and repeats letters	Adult points to letters
Print Awareness	Computer provides written text	Adult reads and points to text
	Computer reads and highlights text	
	Computer offers click to turn page and read options on each	Adult allows child to turn pages or reads requested words on the

	page	page
Phonological Awareness	Computer offers word pronunciation	Adult blends and segments words
Use and Understanding of Language	Computer asks questions about book (e.g., who what, how, when, and where)	Adults asks questions about book (e.g., who what, how, when, and where)
	Characters talk in various voices	Adult uses voices to indicate different characters
	Computer defines words	Adult explains word meaning
Comprehension	Computer offers animations to support the text	Adult offers explanation of what is happening within the story
	Computer offers repeated readings of the storybook to support understanding of story plot	Adult offer repeated readings of text to support understanding of story plot
Reading Engagement and Expansion Activities	Digital animations, sounds, games, and activities within play and read modes	Adult voices, questions, and facial expressions, and reading manipulatives (e.g., puppets, etc.)

Teachers use e-storybooks with students who require the motivation of digital media effects to become engaged in reading. Reading engagement refers to the ability of a student to sustain attention to reading over time (Dunst, McWilliam, & Holbert, 1986; Guthrie et al., 1999;

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Guthrie & Cox, 1998; Kaderavek & Sulzby, 1994; McWilliam, Scarborough, & Kim, 2003). Engaged students may better attend to the reading task by pointing to pictures and engaging in discussion about the book (McWilliam et al., 2003). A number of studies highlight benefits of e-storybooks on reading engagement when compared to traditional books (de Jong & Bus, 2002, 2003; Fisch et al., 2002; Moody et al., in press; Talley et al., 1997).

Specifically, Verhallen et al. (2006) compared reading interactions in 5-year-old children participating in traditional and e-storybook reading interactions and found increased comprehension and vocabulary outcomes in the electronic conditions over the traditional conditions. Talley et al. (1997), found similar results in a study between 4-year-old children with extensive exposure to printed storybooks and their peers with less experience. Findings suggested that e-storybooks assisted in closing the literacy gap for these two participant groups. Additional e-storybook reading studies suggest better story retellings rates (Matthew, 1996; 1997) and better outcomes on comprehension questions (Doty et al., 2001) when compared to traditional adult read storybooks. Finally, Moody et al. (2009) found significantly higher levels of persistence favoring the e-storybook condition over the traditional storybook condition when measuring reading engagement in 3- to 6-year-old children from economically disadvantaged homes. Since reading engagement is associated with short- and long-term outcomes in reading (Frijters, Barron, & Brunello, 2000), teacher often strive to increase student attention to reading tasks using e-storybooks with digital animations.

Scaffolding to Support Emergent Literacy Development

A second theory relates to the concept of scaffolding, an instruction strategy that prompts child learning. Scaffolding should be delivered within the Zone of Proximal Development (ZPD;

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Vygotsky, 1978). This refers to the area of development in which children require assistance to perform. Edyburn (2007) suggests that assistive technologies such as e-storybooks can be employed as a form of differentiated instruction. Scaffolds provided by e-storybooks include the opportunity for children to read independently, review directions, receive immediate feedback, blend and segment words, access electronic dictionaries, and gain comprehension using digital features. Similar scaffolds are used to improve children's emergent literacy skills and oral language development (see Justice & Ezell, 2000; Wasik & Bond, 2001). It is well known that children learn best when taught in their ZPD (de Jong & Bus, 2002; McKenna, Reinking, & Bradley 2003; Talley et al., 1997), and digital features in e-storybooks can provide these supports (McKenna, Reinking, Labbo, & Kieffer, 1999).

Research suggests that e-storybooks can allow children to explore storybook reading mediums without adult assistance which can result in language and comprehension gains (de Jong & Bus, 2002; Doty et al., 2001; Greenlee-Moore & Smith, 1996; Matthew 1996, 1997; Shamir & Korat, 2008). For example, e-storybook features may assist children with word recognition skills by enhancing print by highlighting words and sentences as the computer reads them aloud. With some books, children are also offered opportunities to obtain word pronunciations, which can improve emergent literacy (McKenna, Reinking, & Bradley, 2003). Explicit decoding supports can also include letter-by-letter pronunciations or assist with blending and segmenting of words (e.g., McKenna, 1998). Additionally, read aloud features can improve vocabulary development and encourage repeated readings (Biemiller, 2004; Cunningham & Stanovich, 1997). Finally, positive effects on language and reading engagement are evident when using e-storybooks (de Jong & Bus, 2002, 2003; Doty et al., 2001; Fisch et al., 2002; Moody, Justice, & Cabell, in press). Therefore, it seems possible that the combination of these digital features could produce powerful results if used appropriately and in conjunction with adult led storybook reading activities in the classroom.

Investigations into the effectiveness of scaffolding supports are also present in the research. Korat and Shamir (2008) examined the effects of e-storybooks on 149 kindergartners' emergent literacy skills from low and middle socioeconomic status (SES) groups. Results from pre- and posttest assessments in word meaning, word recognition, and phonological awareness suggest that children's understanding of word meaning improved in play and read only modes. Littleton, Wood, and Chera (2006) investigated phonological awareness skills in 5- year old children using e-storybooks. Data suggested that boys with lower phonological awareness skills at pretest showed significantly higher skills in the posttest than boys who had higher phonological skills on the pretest due to their willingness to use the digital features of the book to listen, repeat, and practice word pronunciations.

Notable benefits of adult mediation have also emerged in extant e-storybook literature. For example, Segal-Drori, Korat, Shamir and Klein (2009) found greater increases in 128 Kindergarten children's phonological awareness and word reading than other groups without adult instruction. Higgins and Hess (1999) found that grade 3 students showed greater gains in their vocabulary when an adult provided additional instruction and encouraged children to link new and prior knowledge from e-storybooks over e-storybooks alone. Additionally, results indicated greater gains for children when exposed to the read and play and read with dictionary modes when compared to the read only mode. Verhallen, Bus, and de Jong (2006), examined the effects of e-storybooks on children's comprehension and results suggested that single reading of the e-storybook were more effective than the adult read, repeated e-storybook readings, and static e-storybook conditions in second language learners. Segers, Takke, and Verhoeven (2004)

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also found differences favoring teacher read alouds over e-storybooks when examining vocabulary development in second language learners. Finally, Matthew (1997) compared the effects of interactive e-storybooks with traditional books on comprehension in grade 3 students and results suggested that children in the e-storybooks condition performed better on story retellings than those using traditional books, although students' responses to open-ended comprehension questions showed no significant differences. These results indicate possible benefits of e-storybooks for young children, especially those from low SES and second language learners.

Other studies indicate no differences between e-storybook and traditional storybook conditions suggesting that both types of reading in the classroom may be beneficial to young children who are at risk. For example, de Jong and Bus (2002) completed a similar study with 48 kindergarteners and results suggested that traditional books were more supportive than e-storybooks. In a follow-up study, de Jong and Bus (2004) found no significant differences in comprehension test results when comparing e-storybooks to traditional books. Segers et al. (2004) found similar non-differential results when they examined comprehension skills in 71 kindergartners using e-storybooks compared with adult read alouds. These studies suggest possible benefits for young children who want to explore and read e-storybooks to supplement their traditional read alouds and classroom reading experiences. Finally, Wood (2005) assessed phonological awareness skills in 80 Kindergarten children and found no significant differences between the e-storybook and traditional book conditions, however, posttests indicated greater gains in rhyme awareness for the e-storybook.

Research on e-storybooks continues to provide more information about benefits. Additional attention should be paid to controversies surrounding use of e-storybooks in classroom to avoid pitfalls for educators and children. While e-storybooks have some supportive characteristics, others are less favorable in supporting emergent literacy development.

Using E-Storybook in the Classroom

Controversies do exist about when and how to use e-storybooks to support emergent literacy development in the classroom. These issues include concerns about the developmental appropriateness of e-storybooks, considerations about matching digital features within books to emergent literacy goals, and information regarding the overall quality of research behind e-storybook use for young children.

Choosing Developmentally Appropriate E-storybooks

In efforts to assist educators with making quality choices about e-storybook purchases researchers are beginning to report on the instructional effectiveness of digital e-storybook features and to develop product evaluation guidelines. Educators should examine digital features and their functions as well as the developmental appropriateness of the e-storybooks in their classrooms. Developmentally appropriate practice (DAP) is defined by the National Association for the Education of Young Children (NAEYC, 1997) as the process by which educators make decisions about how children learn most effectively. This approach recognizes the child as an active participant who develops over time and recommends that three dimensions of appropriateness be considered for young children, including age, individuality, and cultural and social context. By assessing children individually, educators can establish a current level of functioning and then match instruction with the learner’s level. Individual appropriateness describes a child’s unique learning traits including family background, preferences, and experiences. As indicated in the literature (Hart & Risley, 1995; van Kleeck, Gilliam, Hamilton,

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& McGrath, 1997), children who are at risk may enter school behind their peers due to differences in the quality of their interactions, materials, and exposure to learning experiences within the home and other caregiving environments. In light of these differences, children learning experiences should correspond with their developmental needs and emerging skills to promote growth (Bredekamp & Copple, 1997). E-storybooks meeting these criteria may encourage exploration, discovery, choice, and variety while promoting children's creativity and collaborative play (Haugland, 1997). Thus, instructional goals should also be carefully considered before choosing e-storybooks for students.

In regards to developmental appropriateness, the *Evaluation Questionnaire of CD-ROM Storybooks* allows educators to examine the developmental appropriateness and quality of an e-storybook (Shamir & Korat, 2006). This questionnaire is based on developmental guidelines delineated by Haughland and Wright (1997) and de Jong & Bus (2003) and can be used to produce recommendations of worthy electronic books for use with young students. This measure includes the analysis of features that may benefit young students with reading disabilities.

Pairing Digital Features with a Learner's Emergent Literacy Goals

E-storybooks should be chosen by educators to target specific emergent literacy skills (see Table 1). Roskos, Brueck, & Widman (2009), analyzed a sample of 50 mixed-genre (informational and narrative) from five popular online sources for teachers and parents. Results suggested that for e-storybooks to be considered high quality they should facilitate learning by using a design that "has to function at every juncture in the construction" (p.234). Thus, digital features found in products should aim to produce gains in emergent literacy development in some way. To review, digital features can serve multiple function including vocabulary

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development, decoding scaffolds, plot comprehension, and more. Thus, Educators should carefully select e-storybooks that are designed with features that fit a child's individual needs. According to Roskos et al. (2009) and their examination of the extant literature on e-storybook design (see de Jong & Bus, 2003, Shamir & Korat, 2009; Bus et al., 2009), considerations about design should include the following: (1) multimedia design for presentation of words and pictures, (2) interface design for format and control, and (3) learning design for purpose, content , and feedback. Educators can use this information. Specifically, each constructed digital features provides a specific type of support for an emerging readers. Educators should consider the content and function of e-storybook features before assigning books to young readers.

Distracting E-storybook Features

While teachers may find e-storybooks to be useful reading intervention tools for the classroom, they should use a critical eye when selecting e-storybooks. Today e-storybooks come in many forms with varying digital features and titles. Educators should be cognizant of current research when considering which e-storybook features so they do not purchase products with potentially unsupportive features. In a recent meta-analysis of e-storybooks (Zucker et al., 2009), researchers examined 7 experimental studies,11 quasi-experimental, and 9 qualitative studies examining e-storybook use for students in pre-K to grade 5, published in English between January 1997 to January 2007. Findings suggest that digital animations range from "supportive, supplementary, considerate hotspots" to "unsupportive, incidental, inconsiderate hotspots that are irrelevant to the story, distracting, and often unrealistic" (Zucker et al., 2009, p. 78). These findings are consistent with the extant literature describing some digital features as disengaging and superfluous can decrease comprehension of the story (Trushell et al., 2003; Labbo & Kuhn, 2000). Educators are also encouraged to search for e-storybooks with features that match the individual needs of students in their classrooms. This should include the inclusion of developmentally appropriate text and features as well as alignment with individual instructional goals (Lewis, 1998). It is also essential to observe children using e-storybooks, provide directions for use, and encourage use of beneficial digital features (e.g., word pronunciations, dictionaries, etc.) versus distracting and incidental features.

Research suggests that embedded hotspots and animations designed to make the reading experience entertaining or can be distracting (Kamil, Intrator, & Kim, 2000). Similarly, a study by Labbo and Kuhn (2000) suggests that hotspots may encourage passive participation, distract learners from text thereby impeding comprehension. Lefever-Davis and Pearman (2005) completed a study on e-storybooks and found that some first-grade children appeared to be passive observers in the e-storybook and did not engage with the computer or gain benefits from the digital features such s word pronunciations, decoding, or animations. Finally, digital animations that are enjoyable for children can actually distract them and limit their exposure to text (Trushell, Burrell, & Maitland, 2001).

In a study investigating the supportiveness of digital features for 3 to 7 year olds in e-storybooks, de Jong and Bus (2003) found that characteristics such as games and unsupportive animations tended to detract from the story. Korat and Shamir (2004) completed a similar study on 43 Hebrew e-storybooks and found congruent results. They reported positive features to include oral reading options, appearance of printed text, and supportive animations. Both of these studies highlight a limited number of dictionary options that can potentially assist students with vocabulary and comprehension. Other recommended features include segmented speech feedback and word pronunciation tools (Lewin, 1998).

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Research Quality

Zucker et al. (2009) reported a limited number of quality studies on e-storybooks making evidence-based instructional decision making a challenge for teachers. Of those available, 42.9% of experimental studies being of high quality in a recent meta-analysis. This finding was due to the fact that 43% of the researcher provided evidence of reliability of their outcome measures. When examining quasi-experimental studies, small sample sizes were found in 45.5% of the studies rated, indicating groups of 50 or fewer children in the studies. Overall findings looked at effectiveness for e-storybooks in decoding and comprehension. For decoding, the effect sizes ranged from $d = -0.18$ to $d = 0.19$ with an average, unweighted effect of $d = 0.005$, although results were on only two studies, making findings statistically insignificant. For comprehension outcomes, Zucker et al. (2009) found an average ES of $d = 0.45$, suggesting moderate to small effects. Based on these findings, educators should advocate for additional research in this area to determine whether e-storybooks effectively support children who are developing emergent literacy skills.

Summary of Implications for Educators

Research indicates possible benefits of e-storybooks use for children who are struggling to learn to read. Specifically, studies suggest that digital supports available in e-storybooks can support reading engagement, vocabulary development, comprehension, and phonological awareness skills in young children through the use of digital scaffolding supports (see Zucker et al., 2009). Educators interested in making evidence-based instructional decisions should consider specific strategies for choosing and using e-storybooks in the classroom. These strategies include choosing developmentally appropriate storybooks, using e-storybooks in addition to traditional print books, pairing adult instruction with e-storybooks, and monitoring distracting features embedded in e-storybooks (see Moody et al., in press).

E-storybooks may be more effective for young children if educators provide developmentally appropriate e-storybooks that limit digital features that are unrelated to the story. These can serve as distractions for children and limit their comprehension of the story (Trushell, Burrell, & Maitland, 2001. Educators should also consider apply rules for -storybook use in the classroom (see Mercer et al., 2008; Underwood, 2000; Wood et al., 2005). These rules should include strategies for moving between pages, time expectations for completion, and interactional opportunities with peers. Educators can also support children by playing a role and instructing during the reading. They can do this by using evidence-based storybook reading strategies such as questions, scaffolding, and prompts during readings (see Higgins & Cocks, 1999; Higgins & Hess, 1999; Moody et al., in press; Zucker et al., 2009). By assisting in the e-storybook reading educators can support learning and ensure ground rules established early on in the reading are being adhered to.

Finally, teachers should consider which books have digital features that best support a child's emergent literacy needs (e.g., decoding, print awareness, etc.) (Roskos et al., 2009). By choosing DAP e-storybooks with digital features that support targeted emergent literacy goals, educators may facilitate emergent literacy development in young beginning readers. Research indicates that children require instruction in oral language, phonological awareness, print awareness, alphabet knowledge, and oral language (Justice, Chow, Capellini, & Flanigan, 2003). It seems possible that educators who consider the functions of digital features and then intentionally pair a reader with a book based upon specific scaffolding supports will achieve higher levels of emergent literacy development.

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These suggestions may assist educators in effectively presenting and using e-storybooks to support emergent literacy development in the classroom. As with all innovative technology applications, it remains unclear whether long term effects of emergent literacy skills and increased engagement will persist based upon current research. Thus, further investigations would be helpful as educators determine best practices within the classroom. As technology gains a stronger influence within the classroom is essential to continue examinations into how it can be used as an effective tool for emergent literacy instruction.

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The Full Stop Effect: Using Readability Statistics with Young Writers

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Abstract

Readability statistics can be easily generated using word processing packages or through the Internet. In this project, 103 ten-year-old students wrote for 30 minutes on the topic of rainbows, being specifically instructed to pay attention toward punctuation. Readability statistics were generated for each product. However, initially, much of the computer-generated feedback appeared meaningless. For example, high grade levels were assigned to apparently poor writing. A closer inspection of the written products revealed 64 students had omitted full stops (periods). The insertion of full stops, in appropriate places, considerably altered the incongruous feedback information. Remediation sessions were used to teach students to recognize 'faulty' statistics generated by their own products. This brief instruction then enabled them to use the computer-generated objective feedback to make their work more readable. Addressing surface features, such as the effective insertion of full stops, frees the student to concentrate on deeper aspects of the written text.

Introduction

Writing high quality, readable text does not come easily to most young children. Many elementary school teachers express frustration at the apparent poor written products emerging from their students. However, a large body of research has indeed indicated that students will benefit from clear and strong instruction in this area (Bruning, Schraw, Norby, & Ronning, 2004; Graham & Harris, 1993, 2000; Graham & Perin, 2007; Hillocks, 1986; MacArthur, Graham, & Fitzgerald, 2006; Sawyer, Graham, & Harris, 1992; Tracy, Reid, & Graham, 2009; Troia & Graham, 2002). Teachers, on the other hand, are hard put to carry out such instruction, which may entail considerable individual tuition and feedback.

Teachers are familiar with the results of asking students to edit their work in whole class contexts. For the most part, students insist they have reread their work, yet make few, if any, changes. Writers find it difficult to locate their own errors, as they tend to read what they think is written, rather than what actually is written (Daneman & Stainton, 1993; Pilotti & Chodorow, 2009; Rogers & Graham, 2008). Reading aloud to oneself or another person has been found to be helpful (Graves, 1983; Murray, 1984). But, given the context and reality of classroom instruction, a fundamental issue concerns the relative absence of corrective feedback given to the individual. Can feedback from a computer help?

The present project was concerned with using a readily available technology as feedback to encourage young writers. The lead author has served as a key Information, Communication and Technologies (ICT) advisor in South Australian schools for 10 years, specifically encouraging teachers to develop professional skills and use the full range of ICT and Internet resources available to them and their students. The recent experience of working with Robin, a dedicated and hard working elementary school teacher, is typical of a situation seen to occur repeatedly. That is, a teacher may present with an initial openness to attempt a new skill, and a willingness to introduce a new procedure into classroom practice, but then becomes quickly discouraged at the first obstacle.

Following advice to use readability statistics, Robin, became increasingly frustrated after 'discovering' apparent grade levels, on the Flesch-Kincaid scale, ranging from 1.7 to an absurd 89.1, within his class. In addition, some of the poorer writers had higher grade levels, on this scale, than better writers. Furthermore, reading ease scores ranged from zero to 99.9. Robin could not interpret this feedback and declared the practice meaningless.

Despite readability statistics being readily available, per modern word processing packages and through a number of websites (see Appendix A), their use is restricted if the feedback is not understood. This article examines ways in which teachers, such as Robin, can learn how to use such tools effectively. Indeed, the lead author’s experience is that students can be empowered to use computer-generated feedback to improve the quality of their written texts.

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Readability

What is Readability?

Readability refers to the ease with which text can be read. For example, Dr Seuss books are easily read. Professional medical journals are very difficult to read. Readability is distinct from legibility, which relates to handwriting or fonts used in the presentation of text on particular backgrounds. Both the content of the written text and the use of language conventions, such as punctuation marks and paragraphing, are important in readability. A text needs to be readable for the writer to communicate the intended message. A text that is difficult to read is difficult to comprehend. In essence, readability is a prerequisite for comprehensibility.

Educators in the 1920's discovered the level of difficulty of a text could be predicted using sentence length and vocabulary (Lively & Pressey, 1923; Thorndike, 1916; Vogel & Washburne, 1928). Research in this area flourished in the 1950's and included the development of many formulas for calculating readability (Dale & Chall, 1948; Farr, Jenkins, & Paterson, 1951; Flesch, 1950; Fry, 1968; Powers, Sumner, & Kearl, 1958; Spache, 1953). In 2010, the ERIC database had over 2,700 citations under the search term *readability*.

Readability formulas have been used as an educational tool to match readers to texts in schools, and also in business and the military. In the 1950s, Associated Press hired Rudolf Flesch, creator of the Flesch Reading Ease score (FRE), to assist in making newspaper articles more readable, an issue that is apparently still alive today (Dalecki, Lasorsa, & Lewis, 2009).

However, "readability formulas are not writeability formulas" (Fry, 1989, p. 293). Readability formulas were not designed to guide writers. Klare (1984) insisted they have a prediction function, rather than a production function. They measure the readability of a piece of writing for a hypothetical (normative and virtual) audience, rather than providing instruction in text generation. Nevertheless, a young writer might be able to profit from readability feedback, as generated easily through current technologies.

Readability Formulas

Most readability formulas are based on two measures: syntactic difficulty, and semantic difficulty. Syntactic difficulty (grammatical complexity) is measured by sentence length. Semantic difficulty (meaning or word meaning) is measured either by word length or word frequency. The number of syllables, or the number of letters, per word, calculates word length. Word frequency is based on the number of times particular words appear or by comparing the words written with a list of familiar words (Fry, 2002).

In the period prior to 1984, as researchers experimented with variables affecting readability, some 200 readability formulas were proposed (DuBay, 2004; Fry, 2002; Klare, 1984). In essence, there is no one single or 'correct' readability formula. Table 1 shows some commonly used formulas.

Flesch Readability Ease and Flesch-Kincaid Grade Level

Calculation of Flesch Reading Ease (FRE) score uses the average number of words per sentence and the average number of syllables per word. This can be expressed as FRE = 206.835 – 1.015 (total words/total sentences) – 84.6 (total syllables/total words). To calculate the FRE manually, select a 100-word written sample. Calculate the average sentence length and multiply by 1.015. Next, count the number of syllables in the 100-word sample and multiply by 0.846. Add together the average sentence length calculated, and the number of syllables calculated. Subtract this sum from 206.835. The result is the reading ease score (Flesch, 1951). Understanding how FRE scores are calculated help classroom teachers realise the impact sentence length and multisyllabic words have on the resulting score. Busy classroom teachers do not have the time to perform these laborious calculations for each child in their class. However, a computer can calculate an FRE score in a matter of seconds, making this data readily available to the classroom teacher and each student.

Table 1
Selection of Readability Formulas Depending on Words and Sentences

Readability Formula	No. words	No. sentences	No. syllables
Flesch Readability Ease	✓	✓	✓
Flesch-Kincaid Grade Level	✓	✓	✓
SMOG (McLaughlin, 1969)			✓ 3 or more syllable words in 30 sentences
FORECAST (Sticht, 1975)			✓ single syllable words per 150 words
Fry's Graph (Fry, 1968)		✓ in 100 words (3 samples)	Av syllables per 100 words (3 samples)
Gunning fog index (Gunning, 1968)		Av sentence length per 100 words	✓ no. syllables in 100 words

Note: the ticks indicate the criteria used within the formula

FRE scores can be converted into more easily understood US grades. Called the Flesch-Kincaid Grade Level (F-K GL), it is calculated using the average sentence length (ASL) and the average number of syllables per word (ASW). Counting the number of words in the text and dividing by the number of sentences calculates the ASL. Counting the total number of syllables in the text and dividing this number by the number of words calculates the ASW. The calculations are used in the following formula to generate the grade level. F-K GL = (.39 x ASL) + (11.8 x ASW) – 15.59 (DuBay, 2004). The grade levels indicate the number of years schooling required to read the text, and approximate with those used in Australia, with students turning 18 years in Year 12. On average, students in Year 4 are nine years old, turning 10, whilst those in Year 5 are 10 years old, turning eleven.

The highest readability score is around the 120 mark, where every sentence consists of one or two syllable words. *The Cat in the Hat* (Dr Seuss, 1957), for example, has a FRE of 118.1 and a Flesch-Kincaid grade level of less than one. Of the 1,603 words, only five words had more than two syllables.

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The word *another* is used three times and the hyphenated words, *up-up-up* and *fun-in-a-box*, make up the other two. On average, sentences in *The Cat in the Hat* have seven words and these words, on average, have one syllable. The shorter the sentence, and the fewer syllables per word, the easier the text is to read. Flesch (1951) described a score of 90-100 as very easy, 80-90 as easy, 70-80 as fairly easy, 60-70 as standard, 50-60 as fairly difficult, 30-50 as difficult, and 0-30 as very difficult.

Applying Readability Formulas

Robin, teaching the Year 5 class, should be concerned about the writing of students with low FRE scores. A score of zero is problematic whereas a score of 99.9 indicates the writing is very easy to read. Writing scoring low grade levels are not a problem. Dr Seuss, the pen name for Theodore Seuss Geisel, was an accomplished American writer with over 60 published books. *The Cat in the Hat*, a best seller, has a remarkably low grade level. However, grade levels of 89.1 and 14.4 should alert Robin to problems in writing in his Year 5 class.

A 4,300 word article, *New Drugs, Old Drugs* published in the *Medical Journal of Australia* had a FRE of 30 (very difficult) and an F-K grade level of 13.7 (university undergraduate level) (Verma, 2010). The writer used over 1,200 complex words (28% of total word count) including words in common use such as *therapeutic, administration* and *elective*; and less common words such as *thromboprophylactic, pharmacokinetics* and *bioavailability*. The sentences were evidently lengthy, with an average of 19 words per sentence.

Coincidentally, both *The Cat in the Hat* and *New Drugs, Old Drugs* have the same number of sentences. Apart from that, their readability statistics are vastly different as Table 2 shows. Sentence length and syllables per word have a large impact on readability and the scores generated. The readability of this current article is also shown on Table 2.

Table 2
A Comparison of a Simple Text, a Complex Text and this Article

	The Cat in the Hat	*New Drugs, Old*	*The Full Stop Effect*

	(Dr Seuss, 1957)	*Drugs* (Verma, 2010)	(This article)
Flesch Reading Ease Score	118.1	30	69.7
Flesch-Kincaid Grade Level	-1.4	13.7	6.9
Word count	1603	4,319	8161
Complex word count	5	1212	1233
Sentence count	231	231	604
Average syllables per word	0.97	1.87	1.46
Average words per sentence	7	19	13.51

Note: data generated by Edit Central

Criticism of Readability Formulas

Readability formulas are not without their critics. Crossley et al. (2008), writing from a second language perspective, criticize readability formulas because they focus on the surface-level linguistic features of the text rather than the processes a reader brings to the text. Flesch (1951) acknowledged that readability was not dependent on ease of reading alone. Human interest level was also important. This interest is not in the subject but in the presentation of the subject. Consequently, Flesch provided a way of calculating the human interest level based upon the number of personal words and personal sentences in the writing, but this aspect is not represented in any of the readily available resources today.

Critics note that pronunciation of words such as *medicine*, *comparable* and *laboratory* have different syllable counts according to regional dialects. Whilst this is the case, agreeing to abide by the rule that each syllable must have a vowel sound and focusing on the written language rather than spoken language, variations are avoided, e.g. *med-i-cine, com-par-a-ble, lab-or-a-tor-y*.

It is apparent that text can be rated as 'readable' although it may not be immediately comprehensible. Incorrect spelling also makes writing difficult to read. For example:

> At home I have a poorarn and her name is coco. She likes to Play waser me and my bunes soweball and beurcs. One day my dog coco lekerd my buned sowe ball. *(Year 4 boy)*

This story was given a very easy to read FRE score of 93.1 despite being difficult to read. The story was about a Pomeranian dog, Coco, who likes to play with the writer and his bunnies, Snowball and

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Beurcs. Readability formulas can also be criticized for grammatical insensitivity. A scrambled sentence is given the same readability score as an unscrambled one. Hence, by valuing surface features, such formulas can give apparently high readings on text that is 'readable' but not 'comprehensible'.

Such criticisms emphasize that readability is not the only important factor to consider when writing. Readability statistics are useful for checking the readability of writing but many additional criteria are necessary to guarantee genuinely comprehensible text.

Notwithstanding such issues, in general, readability formulas do predict how easy a particular piece of text will be for an average reader, and these are frequently based on two factors, sentence length and word length. As such, readability formulas have a heuristic value.

Generating Readability Statistics

The extent to which young students can use a computer to generate and benefit from readability statistics is unknown. The written text can be copied and pasted into Internet sites such as *Edit Central* (2009). (See Appendix A for a range of online readability calculators). In a matter of milliseconds, statistical data is presented in both graphical and text formats. Word processing packages also include readability statistics as part of their spelling and grammar checks. For example, *Microsoft Word 2007* generates readability statistics through the *Word Options* found under the *Office Button.* Selecting the *Review* ribbon and *Spelling and Grammar* in the *Proofing* section allows the writer to click through the dialogue box until the readability statistics are presented. *Microsoft Word 2007* presents counts (words, characters, paragraphs and sentences), averages (sentences per paragraph, words per sentence and characters per word) and readability (passive sentences, Flesch Reading Ease and Flesch-Kincaid Grade Level). It is not possible to copy and paste the generated statistics next to the written text unless a screen capturing process is used. This makes *Microsoft Word 2007* readability statistics less user-friendly than available internet sites.

The statistics generated are not identical due to the application of different 'rules.' For example, in Table 3, *Edit Central* counts three sentences by presuming there would be a full stop at the end of the writing. On the other hand, Microsoft *Word* counts two sentences by recognizing the full stops. Calculation of FRE scores and F-K grade levels is dependent on the number of sentences so consequently they vary too. These variations highlight the predictive nature of readability statistics. Despite appearances, the numbers generated by the formulas are not precise. Instead, they are indicative of general readability. The FRE scores and the F-K grade levels, generated by the same formulas but applying different 'rules' for sentence recognition, all indicate the text in Table 3 needs improvement in order to be more readable.

Potential for Using Readability Statistics as Feedback

It has been widely documented that conferencing a student during the writing process provides valuable feedback and improves the quality of the written product (Baker, Gersten, & Graham, 2003; Graves, 1983). A study with young adults in a business and technical writing course found readability statistics, along with qualitative feedback, helped students write more readable text (Schwartz, 1980). However, Schwartz recommended students who have errors in punctuation and sentence structure should avoid using the formulas since inflated grade levels are likely to be generated. However, an alternative view would be to help students themselves see that inflated grade level readings are created by punctuation errors that can be remediated relatively easily. In short, discrepant readability statistics can themselves be the signal that the writing product needs revision.

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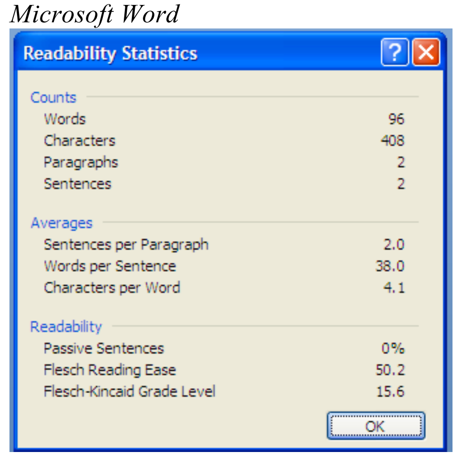
Table 3
Writing Sample and Readability Statistics

Year 5 Original Text	Readability Statistics generated by *Edit Central*	Readability Statistics generated by *Microsoft Word*
One bright sunny after noon my family went for a trip to the outback well my family loves to travel around Australia it isn't like just hoping in the car and driving around the coast of Australia its basically you stay at one thousand places and you visit a lot of people and places. When we got home from the out back we went to Sydney and saw the Sydney harbour bridge, the Sydney opera house. The day after that it was pouring with rain when the rain had stoped there was a beautiful coloured rainbow	Flesch reading ease score: 67.7 Automated readability index: 14.4 Flesch-Kincaid grade level: 11.8 Coleman-Liau index: 8 Gunning fog index: 15.7 SMOG index: 11.4 509 characters 408 non-space characters 404 letters/numbers 96 words 7 complex words 121 syllables 3 sentences 4.21 chars per word 1.26 syllables per word 32 words per sentence	

Writers need feedback during the process of writing as well as for the finished product. According to Hattie and Timperley (2007), effective feedback answers three major questions: (a) what are the current goals, (b) what progress is being made toward the goals, and (c) what activities need to be undertaken to make better progress? The writer aims to communicate his or her message to a reader. The writing needs to be readable. Feedback, given to the writer through an agent such as a peer, an adult, a self-directed checklist, or a computer, can enhance the

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learning of the student. Readability statistics, generated easily by a computer, provide the student with task-relevant feedback about the readability of their work so far. This is powerful feedback in that it shows students the progress they are making towards producing readable writing. A low FRE score signals punctuation problems that the student can address, either by himself or herself, or by seeking help from another agent (peer, teacher, or parent).

Feedback is goal-related. Goal setting affects motivation for engaging in tasks. Adaptive goals are **s**pecific, **m**easurable, **a**chievable, **r**ealistic, and achieved in a **t**imely manner (SMART) (O'Neill, 2000). Specific goals lead to specific feedback (Locke & Latham, 1984). Students could set goals for their writing such as, "I want to polish my writing so that the FRE score is between 90 and 100 so that my buddy in the Year 2 classroom can read it. This means I need to achieve a grade level score of two or less." Once the specific goal is set, the writer can make changes to his or her written text in order to meet this SMART goal.

An elementary teacher has up to 30 students to conference in a normal classroom setting. Elementary students frequently make errors in punctuation. Teaching students how to use readability statistics to check their writing means they would be less dependent on the teacher for part of the lesson time.

The aim of the present project was to investigate ways in which teachers might be able to use readability statistics to help students edit their work. Instead of casting the incongruous statistics aside as 'nonsense,' we may consider what problems such inharmonious information might be signalling. This approach could provide support for the teacher who has the responsibility to help up to 30 students write to the best of their ability.

Research Bases Examples

Participants

One hundred and three students from a large, government school located in a middle socio-economic status district in South Australia participated in a study of children writing using computers. The participants were in their normal classroom groups and consisted of a Year 4 class, two composite Year 4/5 classes and two Year 5 classes. The median chronological age was 9 years 10 months and the mean reading age was also 9 years 10 months according to the locally used test (Waddington, 2000).

Method

In the context of a normal writing lesson, the students were asked to write original stories for 30-minutes on the theme of 'rainbows'. In the lesson, talking and collaboration was not permitted. After 25-minutes, specific instructions were given to the students requiring them to reread what they had written and add any missing punctuation, such as full stops and commas. Students written products were saved on a server.

An initial set of readability statistics was generated using *Edit Central.* Students were percentile ranked for both their FRE score and F-K grade level. A particular problem was noted running throughout the stories and across all five classes. Full stops (i.e. periods) were omitted by 64 of the 103 students, a problem evident across all five classes as indicated by a non-significant chi-square coefficient. The stories were reread by the author and full stops added at appropriate junctures. A new set of readability statistics was generated. Students were re-ranked for the new FRE score and new F-K grade level.

Results and Discussion

Initial Scores

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The initial Flesch Reading Ease scores ranged from -116.1 (extremely difficult to read) to 115.5 (very easy to read). The FRE scores of the five classes did not differ significantly, $F < 1$. The FRE scores of the Year 4 and Year 5 students were not significantly different, $F(1, 102) = 1.26$, $p = .26$. The mean FRE score, uncorrected for full stops, for the 103 students was 83.65. On face value, this seems to be a reasonable readability score, falling into the easy range. However, the mean hides a wide range of scores (-116.1 to 115.5).

The initial Flesch-Kincaid grade levels ranged from -.4 (pre-school) to an impossible 84.5. The mean F-K grade level was 7.8, which seems high for students who have not yet reached that grade level. The mean F-K grade level of the Year 4 students and the Year 5 students was significantly different, $F(1, 101) = 5.04$, $p = .03$. The writing of the Year 4 students had a mean F-K grade level of 4.8 (SD = 4.0) whilst the Year 5s was 9.7 (SD = 13.56). A very capable group of Year 4 writers could possibly achieve a grade level of 4.8 but it is unlikely that a Year 5 group would be writing narratives that could only be read by students in much higher grades. Obviously, the effect of outliers actively helped to produce overall faulty readings.

Table 4 shows the readability statistics for the bottom 10 per cent of students, ranked according to their FRE scores. Aside from their FRE scores being low and their F-K grade levels being high it is obvious that the number of sentences written is low and the number of words per sentence surpasses that of a complex medical journal article (average of 19 in Verma's text). For Year 4 and Year 5 students these are incongruous readability statistics.

Table 4
Original (Incongruous) Readability Statistics as Shown by Ten Students

Student	1	2	3	4	5	6	7	8	9	10
FRE	-116.0	-51.0	8.3	43.2	45.1	57.7	58.4	59.5	62.0	62.6
F-K grade level	84.4	59.4	40.2	24.7	24.4	19.4	15.1	19.6	14.3	16.3
Sentence count	1	1	1	3	2	2	1	5	7	1

Average words per sentence	221	157	113	70	70	57	40	59	39	40
Average syllables per word	1.17	1.17	0.99	1.09	1.07	1.08	1.28	1.03	1.25	1.23
Word count	221	157	113	211	140	114	40	295	272	40

Generating New Scores by Adding Full Stops

As noted earlier, inspection of the written text revealed the curious observation that 64 out of 103 (65%) students had omitted full stops (i.e. periods). This occurred despite specific instructions given at the 25-minute mark.

Since readability statistics are driven by sentence length, it was decided to investigate the impact of adding appropriate full stops into the students' stories. Each story was reread and 460 full stops were added to the 64 stories in order to make the texts comprehensible (average of seven full stops per story, SD = 5.06). Once full stops were added, the new set of readability statistics, in some cases, showed dramatic changes in FRE scores, F-K grade levels and sentence counts. Word count and average syllables per word remain unaltered (see Table 5).

Table 5
Corrected Readability Statistics for the Same Ten Students

Student	1	2	3	4	5	6	7	8	9	10
FRE	80.0	99.8	114.2	99.3	98.4	106.7	85.4	100.7	81.7	82.9
F-K grade level	9.0	1.4	-0.4	3.2	3.9	0.6	4.7	3.8	6.7	6.7
Sentence count	8	19	13	14	8	13	3	16	14	2
Average words per sentence	28	8	9	15	18	9	13	18	19	20
Average syllables per word	1.17	1.17	0.99	1.09	1.07	1.08	1.28	1.03	1.25	1.23
Word count	221	157	113	211	140	114	40	295	272	40

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Focusing on Low Incongruous Scores

A closer look at students with initial exceptionally low FRE scores revealed three students with the exceptionally low scores of -116, -51 and 8.3. The next lowest score was 43.2 but from thereon the intervals between scores were much smaller (maximum jump of 12). Only 15 per cent of students obtained an uncorrected FRE score of less than 70.

The original text of the student obtaining an FRE of -116 consisted of one sentence of 221 words with many joining words such as *and, but* and *so*. Adding full stops in appropriate places realigned his FRE score to 80. Removing some conjunctions would further enhance this score. His work was still in the first percentile, despite the addition of full stops.

The student with an original FRE score of -51 appeared to write just one sentence, but the addition of 18 full stops dramatically enhanced the readability of his work and moved him from the second to the sixty-fourth percentile. His F-K grade level dropped from an incongruous 59.4 to a realistic 1.4.

The addition of full stops to the text written by the student with an original FRE score of 8.3 showed an even more dramatic “improvement”. His apparent one sentence became thirteen, and he moved from the third to the ninety-ninth percentile. His F-K grade level dropped from 40.2 to less than one. The student with an original FRE score of 43 achieved a similar result. Her apparent three sentences became fourteen, and she moved from the fourth to the sixty-third percentile. Her F-K grade level also dropped from 24.7 to 3.2. A student with an FRE score of 45.1 made a lesser percentile jump but she did move from the fifth to the 53rd percentile and the readability of her text became very easy (FRE 98.4). Her F-K grade level also dropped from 24.4 to 3.9.

In short, adding full stops into the student products had dramatic effects on readability in the case of several key students.

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Comparison of FRE Scores in Uncorrected and Corrected Text

Turning attention to FRE scores by comparing the uncorrected and corrected text may help determine the FRE score a 10-year-old student should aim for in their writing. As mentioned, the FRE mean, uncorrected for full stops, hides an enormous range of scores (-116.0 to 115.5). Once corrected for full stops the mean FRE score moves up into the very easy range (96.17) and the difference between the minimum readability (69.1) and maximum readability (115.1) is much narrower (see Table 6).

Table 6
Mean Flesh Reading Ease Score for Uncorrected and Corrected Text

	Mean Flesch Reading Ease Score	S.D.	Range	Minimum	Maximum
Uncorrected for full stops	83.65	28.87	231.6	-116.0	115.5
Corrected for full stops	96.17	8.86	46.4	69.1	115.5

Even so, a readability score of 69.1 is a matter for concern as these students have a median age of 9 years 10 months and have not reached the stage of writing technical works. An investigation of the story receiving this low score showed that the student had used hyphenated words to increase the complexity of his story. They included *jolly-o, poor-o Scotto, jolly-o-land, jolly-o-boy* and *quite-o-mischievous*. These were in keeping with his story about a leprechaun on Saint Patrick's Day. This story was not one of the ones needing correction for full stops and the FRE score more accurately reflects the complexity of the story.

The student receiving the next lowest FRE score of 75.9 was also one that had not needed correction for full stops. This student wrote a 119-word story about the spirit world in which the main character was Kawakawato, a five-syllable word. Replacing this five-syllable word with a two-syllable word, Kaka, the FRE score increases to 90.8. A further increase in readability (FRE 95.8) occurs if a one-syllable word, Kale, replaces the five-syllable word. This example highlights the dependence of readability formulas on syllable counts. A teacher looking at this writing sample could reassure the student that their work was quite readable, despite a score of 75.9, and praise the student for using a complex 5-syllable word.

Students were sorted according to their uncorrected FRE score and then again according to their corrected FRE scores. Each student received a percentile score for both the uncorrected text and the corrected text (see Table 7). For the uncorrected FRE scores the lowest 25% of students scored less than 74.4. Only the top 25% of students fell into the very easy readability range. Correcting the FRE scores raised the lowest 25% of students to scores of less than 90.4. In the corrected text, 75% of students fell into the very easy readability range.

Table 7
FRE Maximum Scores According to Percentiles

	Uncorrected FRE Score	Corrected FRE Score
25th percentile	74.4	90.4
50th percentile	89.3	96.6
75th percentile	98.3	102.3

These examples indicate two important ways to use readability statistics. Firstly, a low sentence count may indicate the omission of full stops. Secondly, if the FRE score is less than 90, for a 10-year old writer, then look at the text more closely. The FRE score may indicate that the writer has inserted very few full stops. However, it may also indicate the writer has used words with many syllables. The writer needs to check if full stops are needed. Once these are appropriately inserted, generate a new readability score. If the FRE score is still less than 90, check for multisyllabic words. *Edit Central* underlines words with three or more syllables and labels them 'complex' words, simplifying this task.

Comparison of F-K Grade Levels in Uncorrected and Corrected Text

The mean F-K Grade Level, uncorrected for full stops, for the 103 students was 7.7 (SD 11.02). As these students were either in Year 4 or in Year 5 this figure is unrealistically high. Once corrected for full stops a more realistic grade level of Grade 3 (SD 1.97) resulted (see Table 8).

Table 8
Mean Flesch-Kincaid Grade Level for Corrected and Uncorrected Text

	Mean F-K Grade Level	S.D.	Range	Minimum	Maximum
Uncorrected for full stops	7.71	11.02	85.1	-.7	84.4
Corrected for full stops	3.00	1.97	9.7	-.7	9

Sorting the students according to their uncorrected F-K grade level and then again according to their corrected F-K grade level enabled generation of percentile scores (see Table 9).

Table 9
F-K Grade Level Maximums According to Percentiles

	Uncorrected F-K Grade Level	Corrected F-K Grade Level
25th percentile	2.5	1.4
50th percentile	4.7	2.8
75th percentile	8.2	4.1

It is unrealistic to expect 25% of the Year 4 and Year 5 students would achieve grade level scores of above Grade 8. The omission of full stops had inflated the grade level dramatically. The addition of full stops lowered this to Grade 4. It is reasonable to expect 25% of Year 4 and Year 5 students could achieve a grade level above Grade 4.

Thirty-eight percent of students had no change in their Flesch-Kincaid Grade Level but 26 percent had a change (i.e. reduction) of five grades or more (see Table 10).

Table 10
Percentage of Students with Changes in F-K Grade Levels After the Addition of Full Stops

Change in Grade Level	Percentage
none	38
< 1 grade	9
1 to 2	9
2 to 3	12
3 to 4	9
5 to 10	15
> 10	11

Note: The percentage tally is more than 100 due to the rounding up effect.

It should be noted that a very low grade level is less problematic than a high grade level as students can write text for younger students still learning to read. Not unlike Dr Seuss, several students achieved a grade level of less than one but the quality of their story was high.

Correcting writing by adding full stops, in appropriate places, improves readability (a higher FRE score) and the grade level becomes more realistic. Removing some extraneous conjunctions and making shorter sentences could improve writing samples that still had a low FRE score and a high F-K grade level.

Clinical Follow-up: Teaching Students to Use *Edit Central*

The lead author returned to one of the classes to test the notion that students themselves are able to make sense out of readability feedback data. The class was shown the readability statistics generated for their work, and told there was a problem, in that the 'readability machine' could produce some numbers that did not make sense. For example, a grade level of 12 for a Year 5 writer, and 203 words but only five sentences giving an average of 40 words per sentence. It was explained how this problem could be easily fixed by adding full stops. The students were then directed to fix any similar problems, in their own work, by copying their writing into *Edit Central,* reading the feedback, and duly adding full stops.

As *Edit Central* produces 16 outcomes, students were told to focus only on three: (a) Flesch Reading Ease score (aim for 90 or more but more than 70 may be acceptable), (b) Flesch-Kincaid Grade Level (aim for your grade or less) and (c) words per sentence (aim for a lower number than was currently showing). The first outcome, Flesch Reading Ease, is at the top of the *Edit Central* list and the words per sentence are at the bottom, simplifying access to the information for students. It was apparent that every single student in the class was able to use this information and so obtain appropriate readability feedback for their own work.

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However, within this session, it was noted that two students left a space before the full stop, e.g. ‘He chased them. Then they ran …” It is not readily apparent to the human eye that the space is after ‘them’ and there is no space between the full stop and ‘Then’. The computer is sensitive to these spacing issues and reflects this error in the generated scores. In one case, a Year 5 girl had left spaces before 13 of her newly inserted full stops. Thus, initially she had lowered her Flesch-Kincaid grade level from 10 to eight. However, through shifting the full stop to the appropriate position she reduced the grade level from this unrealistic eight to a more realistic two.

Extension of Use

It is clear 10-year-old students can effectively use the feedback provided by readability statistics to improve the quality of their writing. Schwartz (1980) found a combination of qualitative feedback and feedback from readability statistics enabled young adults to write text that was more readable. It seems reasonable to suggest that, with instruction, students from 10 years of age to adulthood can profit from feedback generated by readability statistics. Younger students, who are able to write complete stories may also benefit but this needs to be tested.

Current feedback from sites like *Edit Central* could be confusing for younger students who would need to scan a 16-point-long list to select the relevant data. Today’s students have grown up with video games. They enjoy the challenge of working through various levels to achieve a successful outcome. There is potential for a web developer to construct a user-friendly readability statistics generator, incorporating levels, to give feedback to writers. The simplest level could provide feedback on the total number of words, the total number of sentences, the average number of words per sentence, the average number of syllables per word and the F-K grade level. Reducing the current list of 16 down to five would still provide young writers with a sense of audience, e.g. I am writing a story that could be ready by a student in grade one. Higher levels could introduce the FRE score and number of complex words.

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Edit Central currently generates a colourful bar graph. A web developer could incorporate more graphics, making the site more appealing to young students. Creating the facility for students to log-on, and save their work, opens up more possibilities. Graphs showing word counts over time could be added, such as those for daily steps walked in a health web-site *10,000 steps* (Queensland Health, 2003-2010). *Edit Central* currently provides the formulae, in the Java programming language, used to generate the various readability scores. An enterprising web developer could use these to start developing a user-friendly site for young writers.

Conclusion

ICT can provide vital feedback to young writers and their teachers. Robin was one of the five teachers whose Year 5 class supplied data for this project. He now understands that grade levels of 89.1 or 14.4 indicate problems in the written text whereas grade levels of 2.8 or 1.7 are realistic for Year 5 writers. Robin knows a high FRE score is preferable to a low score. He can direct his Year 5 students to aim for an FRE score of 90, or more, whilst assuring them a score of 70 or above is acceptable if they have used multi-syllabic words. Robin expects his students to know their written text will have an F-K grade level equivalent to their current grade level or less.

Robin is confident in his use of readability statistics as they provide useful feedback to both himself and his students about their writing. He values readability statistics as offering task-specific feedback, quantifying students' work, and helping them to look at their products in an interestingly different way. His students benefit from an objective computerised report containing the number of sentences they have written, their FRE score and F-K grade level, before they meet for a conference with himself, a parent or a peer. If the sentence count is low and the FRE score, for 10-year olds, is less than 90, students know it is highly likely they need to insert more full stops in appropriate places. Students can edit their work for full stops, and remove excessive conjunctions, then recheck their readability statistics before meeting for a conference.

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As a teacher, Robin knows feedback is most powerful when it follows effective instruction (Hattie & Timperley, 2007). Some students cannot benefit from the readability statistics because they first need help in constructing and recognising sentences. Such students require clear instruction rather than additional feedback. Readability statistics are just one tool in the teachers' toolkit.

Transcribing the writing samples of a whole class would be an arduous task for the classroom teacher. However, if students type their story directly into a computer then only the task of calculating the readability statistics remains. Students could be taught how to do this using *Microsoft Word* inbuilt readability statistics. However, an easier option is to copy and paste written work into an online readability statistics generator, such as *Edit Central*. There is potential for a web developer to create a young writers' user-friendly site by incorporating graphics and levels of challenge. The first level would limit the number of readability statistics generated. Higher levels would provide more extensive, complex readability statistics.

The readability statistics can be used in other ways. For example, teachers could challenge students to increase the number of words they write by keeping a record of word count over a term. Helping students add multi-syllabic words to their vocabulary and their writing could increase the average number of syllables count. Students would need to be trained to note small decimal increases as significant, remembering *The Cat in the Hat* had 0.97 average syllables per word and the complex medical text, where multisyllabic words composed over a quarter of the text, had an average syllable count of 1.87.

In essence, students need help with the complex task of generating clearly written text. Teachers need ways of helping children write better. Used and interpreted appropriately, readability statistics provide objective feedback to students about their written text. Under the guidance of a skilled teacher, students can learn simple ways of improving their writing using readability statistics. The human brain has a superb parsing facility that enables the recognition of sentences, whether full stops are present, or not. Web-based readability formulas are highly sensitive to sentence length and placement of full stops. A computer mechanically computes feedback based only on the data present in the document. This incongruous feedback reinforces the importance of placing full stops appropriately and frees both the teacher and the student to work on deeper aspects of creating readable written text.

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Appendix A: Online Readability Calculators

Edit Central
http://www.editcentral.com/gwt1/EditCentral.html
Copy your text and paste into a box. Displays sixteen readability statistics.

Joe's Web Tools
http://www.joeswebtools.com/text/readability-tests/
Copy your text and paste into a box. Displays six readability statistics.

Tyler, S. K. Writing Sample Analyzer (1996-2010)
http://bluecentauri.com/tools/writer/sample.php
Copy your text, up to 5,000 words, and paste into a box. Displays 3 text features and 3 readability statistics.

Child, D. Added Bytes (2003-2009)
http://www.addedbytes.com/code/readability-score/
Copy your text and paste into a box. Displays seven readability statistics.

Readability Analyzer
http://labs.translated.net/text-readability/
Copy your text and paste into a box. This site grades text as easy, average or hard. Provides a list of potentially hard terms.

Simpson, D. The Readability Test Tool (2009-2010)
http://www.read-able.com/
Generates readability feedback about web pages. Copy and paste a URL into the box. Teachers could find this useful in working out what web pages to allocate as reading for their class. Displays six readability statistics and six text property statistics. An explanation of what the results mean follows the statistics.

Juicy Studio (2000-2010)
http://juicystudio.com/services/readability.php
Explains readability statistics. Test the readability of a website by pasting URL into a box. Displays a mixture of readability statistics and text properties. Calculates number of words with 1, 2, 3, or 4 syllables.

Downloadable Readbility Calculator
Source Forge. Net (2007)
http://flesh.sourceforge.net/
This is an open source Java application, available for download, to your computer. Calculates Flesch Reading Ease Score and Flesch-Kincaid Grade Level after pasting text into a box.

Programming Information

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For information on how to code a microcomputer to generate nine sets of readability statistics, see Schuyler, M. R. (1982). A readability formula for use on microcomputers. *Journal of Reading, 25(6),* 560-591. As part of the code, the Dale and Chall frequent words are listed.

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