TEACHING EMERGING LITERACY SKILLS:
Using Touch Screen Technology and Reading Recovery Inspired Methods

Teaching Emerging Literacy Skills: Using Touch Screen Technology and Reading Recovery Inspired Methods

Leon Lenchner

September, 2009

Teaching Emerging Literacy Skills:
Using Touch Screen Technology and Reading Recovery Inspired Methods

How can the use of interactive touch screen technology and assistive software impact upon students' literacy skills and achievement? This inquiry focuses on three major themes: how interactive touch screen technology can enable both a student and a teacher to engage in an assisted, shared, literacy activity; how the components of technology, pedagogy, and subject content come together to create a collaborative knowledge; and how the passing on of knowledge and skill between a teacher and a student can be mediated by an interactive, 'responsive' computer. More specifically this inquiry explores how the combination of an interactive touch screen computer monitor [a SMART Sympodium DT770] and its enabling software [Notebook Software] in concert with Reading Recovery inspired methods can be used to teach literacy skills to struggling readers. Not all teaching takes place in a large, mainstreamed classroom; this study seeks to explore the relationship of technology and pedagogy as a teacher and a student, sit side by side in a focused individualized touch screen scenario [FITS]. Lesson artifacts developed cumulatively throughout this investigation are included to illustrate the principles discussed and the instructional actions carried out in this report.

Literature Review

Socio-Cultural Theory.

> Passing on knowledge and skill, like any human exchange, involves a subcommunity in interaction. At the minimum, it involves a "teacher" and a "learner" - or if not a teacher in flesh and blood, then a vicarious one like a book, or film, or display, or a "responsive" computer (Bruner 1996. p. 20).

Bruner's statement provides us with an awareness and an opportunity to open up a dialogue around the use of a modern technological artifact in the context of education. Bruner suggests that a "responsive' computer has the capability of opening up new ways of communicating and interacting with a learner.

Developments in the area of digital technology have resulted in the creation of interactive whiteboard [IWB] technology. This technology enables the user to control both the hardware equipment and software application by touching a screen with either a finger or pen. This ability can create an interactive and 'responsive' environment for a learner. Through the use of touch screen technology the learner has the potential to interact directly with the screen allowing for a more authentic or 'real' experience. "Mouse and pen-based interfaces allow the user the immediacy of touching, dragging, and manipulating visually attractive ideograms" (Bolter, 1999, p. 23). The ability to touch the screen creates a sense of immediacy and transparency. As a result a more seamless and authentic interface is created between the technology and the learner. The machine becomes an extension of the physical body (McLuhan, 1964).

Learning takes place in the context of others and knowledge is understood to be socially constructed (Vygotsky,1978). Speech and language can be considered tools or channels through which we communicate and transfer knowledge and skills. Technological tools are capable of providing a similar function and through them we are able to transfer and mediate knowledge and skills. The computer is a tool through which we are capable of transferring knowledge and skills; however, it is more than a tool. A hybrid automobile is a tool that provides us with the ability to transport; it is also a 'sign'. At the same time that it provides the driver with a means of transport and travel, the hybrid is a 'sign' that the driver may be an environmentally conscious citizen. The decision to purchase this type of vehicle, projects to others that the owner may be an environmentally conscious consumer.

In a similar sense, the computer is not only a tool but it is also a 'sign' that transmits meaning about its role and status in contemporary society. By using a computer in the classroom for instruction, we are validating that it is an important medium for communication, mediation and knowledge construction. It also lends credence to the perception that the computer screen has become a major site of representation. Kress explores

> the broad move from the now centuries-long dominance of writing to the new dominance of the image and, on the other hand, the move from the dominance of the medium of the book to the dominance of the medium of the screen. These two together are producing a revolution in the uses and effects of literacy and of associated means for representing and communicating at every level and in every domain (Kress, 2003, p. 1).

The computer is a cultural artifact that is transforming society. This artifact has led us into a universe where digital tools are omnipresent and ubiquitous. We come to expect that digital devices will be part of our daily interactions in many spheres of activity, including education. Might we be at some nexus point where the computer stands head and shoulders above any other educational tool that has preceded it? How does it stack up against the chalkboard or the overhead projector? The impact of the 'responsive' computer is significant in terms of its ability to help mediate the 'passing on of knowledge and skills'. In light of Bruner's statement, what impact does the in-person relationship with the computer have on early literacy instruction and learning, and consequently on the acquisition of early literacy skills?

Role of Teacher.

Bruner alludes to the virtual presence of a teacher in communicating knowledge and skills. The teacher's role is fundamental to the transmission of knowledge and paramount in creating a pedagogy that is effective and responsive. This is summed up in a phrase generally attributed to David Thornburg**,** "Any teacher that can be replaced by a computer deserves to be." Thornburg's statement reinforces the primacy of and the need for an informed teacher in the context of instruction. Sutherland writes that,

> ICT alone will not enrich the learning environment, but rather the focus is on the fundamental role that the teacher plays in how he/she incorporates ICT into the learning activities. It is very important to stress that the impact that ICT has on student learning depends on how ICT is integrated into learning activities as ICT on its own will not improve student learning (Sutherland, 2004 p.6).

According to Sutherland and Thornburg, the teacher plays a key role in determining the impact that ICT will have upon student learning. According to the Ontario College of Teachers (2006, p. 13), it is a teacher's responsibility "to use appropriate pedagogy…resources and technology in planning for the needs of individual students and learning communities". Bearing this in mind a model proposed by Mishra and Koehler (2006) becomes an effective resource in mapping the relationships within the FITS scenario. By extending the work of Shulman (as cited in Mishra and Koehler, 2006), these two researchers have developed the Technology, Pedagogy, Content Knowledge [TPCK] model to explore the use of technology and how it impacts upon the educational actions of practitioners. The TPCK model demonstrates and interrogates the relationships between technology, pedagogy and content. We will be exploring how the components of the TPCK model can provide insight into our teacher practice with the Interactive White Board [IWB].

Multiliteracies and Multiple Ways of Learning.

Studies that evolved from the New London Group (1996) explored the nature of literacy in the 21st Century. The New London Group coined the concept of 'multiliteracies'. Multiliteracies helps us determine what it means to be a literate person in contemporary society, a much broader view of literacy than portrayed by traditional language-based approaches. This view takes into account the "multiple modes of communication to which each of our senses are attuned and multiple ways in which knowledge and skills can be passed" (Williamson, 2005). These multiple ways of knowing are inherent in the media texts of contemporary society.

With the advent of the Internet, the work of the New London Group is even more significant. Interactive touch screen technology is an effective medium for understanding these phenomena.

> Any notes, diagrams, or other images shown on the surface can be printed out and given to students. The use of colour marking on the board in the note taking mode can provide an important dimension in focusing students' attention. Students and teachers can use the whiteboard interactively. Users can write on the board once an image has been projected and the teacher can add comments at the computer or notations at the computer. Students or the instructor at the board can use the markers or their fingers to press on the board and interact with it as one would with a traditional screen and mouse. (Bell, 1998 p. 2).

Bell's work helps to focus our attention on the multimodal aspects of the interactive screen. The ability of students to control the technology with ease and with a certain degree of immediacy, results in a rather engaging experience as described by Solvie (2001). Solvie investigated the correlation between the use of an interactive whiteboard as a delivery tool for literacy instruction and the students' reactions to the SMART Board in a first-grade classroom.

> The SMART Board [interactive whiteboard] was novel and created enthusiasm for learning on the part of the students as evidenced in remarks made during the lessons presented using the SMART Board and during individual student interviews, such as "I like touching the SMART Board," "my finger is magic," "I like when the lines get different," "it's a lot more easy using the interactive whiteboard, but I don't know why," "we used the SMART Board and it went ding, ding, ding," "every part of

> the word is special" and "the board is magic." Students were engaged when they actually touched the SMART Board or manipulated text on it (Solvie, 2001).

Whenever the student approached the board there was a magical feeling and a sense of the dramatic moment. Moss (2007) puts forth the notion that the IWB board creates a 'theatrical tension' and a captivating learning environment in the classroom (Moss as cited in Rudd, 2008 p. 2).

Accessibility and Universal Design.

For many able bodied individuals the design and nature of the environment is not a priority. However for individuals who have accessibility issues the design and architecture of learning spaces are key elements for day to day functioning. Universal Design [UD] is an enabling 'movement' that promotes accessible and universal design principles. According to the Centre for Universal Design organization (2008), their stated mission is "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" and "to improve environments and products through design innovation, research, education and design assistance". UD should be a key consideration when it comes to designing the human and computer interface. With touch screen interactive technology the interface is simplified; it is 'practical and effective'. Through touch screen capablities there is no need for additional mediated devices to input information into the computer. A simple touch of the monitor without the need to control any other type of appliance or tool is much more enabling for the learner. Sentech [Special Education Needs Technology] supports this view as the interactive touch screen provides an alternative to a keyboard and mouse.

> Individual students may need to physically access the computer in a different way from their peers. There is a range of keyboards, keyboard accessories, mice and mouse alternatives, and switches as alternative to keyboard and mouse. Touch monitors & screens as alternative to keyboard and mouse, and the selection and use of these will depend on the physical, cognitive and educational needs of the individual student (2008).

Learning Styles and Special Needs.

Much has been written with respect to the use of technological tools and their enabling quality for students with learning disabilities. For example, printed reading materials pose substantial challenges to students with disabilities. Computers have provided these learners with additional resources. Technology can assist with such difficulties by enabling a shift from printed text to electronic text, and Anderson-Inman and Reinking (1998) assert that text

> can be modified, enhanced, programmed, linked, searched, collapsed, and collaborative. Text styles and font sizes can be modified as needed by readers with visual disabilities; read aloud by a computer-based text-to-speech translator; and integrated with illustrations, videos, and audio (Anderson-Inman and Reinking cited in NCREL 2005). Electronic text affords alternative formats for reading materials that can be customized to match learner needs, can be structured in ways that scaffold the learning process and expand both physical and cognitive access, and can foster new modes of expression through revision and multimedia (J. Zorfass: *Personal Communication,* October 2005). It

represents one way that technology can support the achievement of students with disabilities. (Zorfass cited in NCREL, 2005).

Using interactive hardware and software represents one way that technology can support the achievement of students with disabilities. The resources enable us to differentiate instruction based on student needs. In working with my students, I will be exploring the ability to modify text and the effect that this has on the acquisition of early literacy skills.

Additionally, Helen Irlen (1998) has explored the use of colour-based technology in perceptually-based reading and learning difficulties. According to the Irlen method, this technology has been in development since 1983 and purports to be a “non-invasive, patented technology that uses colored overlays and filters to improve the brain's ability to process visual information.” The resources inherent in SMART Notebook can be used to apply Irlen’s theories. This capability is one that should provide additional visual supports and empowerment to the learner. Selecting the colour characteristics of the text and background can provide a sense of control and agency, on the part of the student.

Teacher Efficacy and Student Agency.

There is link between the teacher perceptions of student performance and the student achievement. “The link between individual teacher efficacy beliefs and student achievement have been demonstrated in number of studies” (Anderson, Green, & Loewen, 1988; Armor et al., 1976; Ashton & Webb, 1986; Ross,1992 as cited in Tschannen-Moran and Barr, 2004 p.195).

This inquiry is the result of the faith that colleagues have placed in the investigator and his use of technology along with Reading Recovery inspired methods. Without this collective trust, this inquiry would not have been possible. The support and encouragement by fellow educators reflects “The perception of teachers in a school that the efforts of the faculty as a whole will have a positive effect on students” (Goddard, Hoy, & Woolfolk Hoy, 2000, p. 480, as cited in Tschannen-Moran and Barr, 2004 p.190).

Throughout the FITS study there are instances where students were provided with choice and personal agency. Students were involved in the selection of materials. Prior to any Reading Recovery inspired intervention, students visited the library and had the opportunity to select books, of their own choice, to read. Students were able to set goals for themselves at the beginning of the program. When students play an active role in their learning they are often more motivated to learn.

Integrating of Technology in Instruction: The TPCK Framework

The theories put forth by Vygotsky and an amalgam of theorists provides us with a powerful conceptual framework upon which to base our explorations of literacy, pedagogy and technology. This in not an unwise approach as the work recently published by Mishra & Koehler (2006, p. 2), encourages the use of a theoretical perspective on the exploration of the current educational uses of computers.

This Venn diagram (Figure 1.) originally developed by Shulman (1986) provides us with the ability to "explore the elements of pedagogy, technology and content as part of the development of a complex, situated form of knowledge that we call Technological Pedagogical Content Knowledge [TPCK]". Shulman's model (as cited in Mishra and Koehler, 2006) is a way of clarifying a teacher's instructional actions and pedagogical choices. Furthermore the focus on content as well as pedagogy should help to inform others of the nuanced nature of these key components and how they relate to each other in the context of technological 'tools'. (Mishra & Koehler, 2006, p. 1023)

More Detailed Description of the (TPCK) Model.

The context for these components is a one on one in-person teaching and learning scenario in a medium sized urban school. They occur in a focused individual touch screen scenario [FITS].

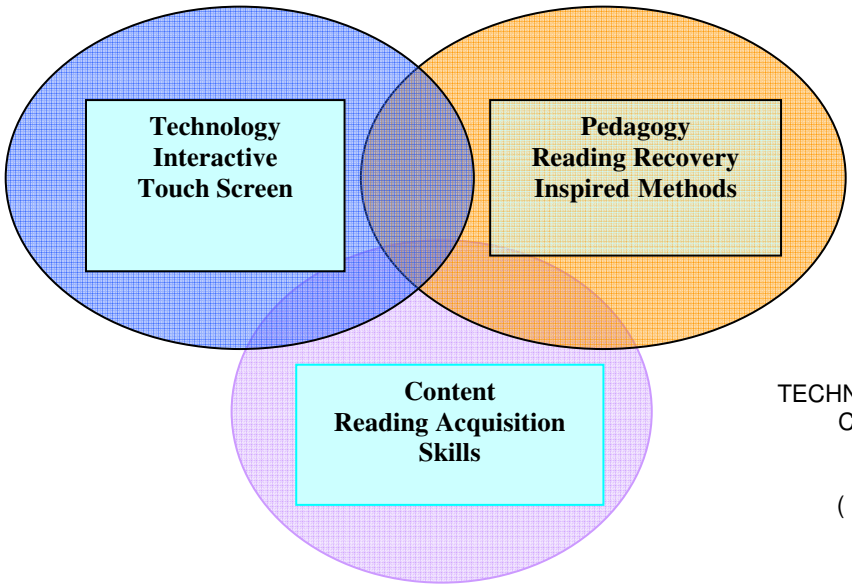

Figure 1.
TECHNOLOGICAL, PEDAGOGICAL, CONTENT KNOWLEDGE FRAMEWORK
TPCK
((Mishra & Koehler, 2006)

The Basis for the Technological Pedagogical Content Knowledge [TPCK] Components: The following addresses each area in greater detail:

Content Knowledge [CK]
relates to the reading and writing process and the acquisition of reading skills;

Pedagogy Knowledge [PK]
relates to Reading Recovery Inspired Methods; and

Technology Knowledge [TK]
relates to the Interactive Touch Screen Technology, specifically SMART DT 770 http://www2.smarttech.com/st/en-US/Products/Interactive+Pen+Displays/DT770/ and its accompanying Notebook software.

http://www2.smarttech.com/st/en-US/Support/Downloads/default.htm

[C] - Content Knowledge. Table 1.0

Actual subject matter
Reading Skills, Emerging Literacy Skills
Central facts, concepts, theories, and procedures:
Letter, Word, Sentence Knowledge, Story Knowledge in continuous text (Clay, 2005a)
Knowledge of explanatory frameworks that organize and connect ideas:
Use of Visual, Structural and Meaning based Sources of Information (Clay, 2002)
Knowledge of the rules of evidence and proof:
Evidences: Field notes, Reading Records and Lesson Artifacts
Teachers must also understand the nature of knowledge:
Orientation, Sequence & Directionality, ability to gain meaning from print (Clay, 2002, 2005a)
Further Description of Content
Central to literacy is the role of visual sources of information. In Reading Recovery inspired methods, students extract meaning from visual sources; students are required to process letters and words in a strategic manner. Interactive technologies are effective methods in supporting learners through a visual modality. Students use the sounds of letters to process phonemic information. Implicit in this process is the one on one, child/adult instructional relationship. It is a process that is mediated by technological tools and artifacts. The Reading Recovery inspired lesson begins with a conversation that attempts to set the stage for learning by triggering prior knowledge.

[PK] - Pedagogy Knowledge (Reading Recovery Inspired Procedures). Table 2.1

Related is deep knowledge about the processes and practices or methods of teaching and learning:
As this is a modified Reading Recovery program it draws on some Reading Recovery procedures; more specifically, this study focuses primarily on those activities related to reading processes. “With more than 30 years of data, Reading Recovery is the world's most widely studied early intervention.” (Reading Recovery, 2009)
Encompasses, among other things, overall educational purposes:
‘Accelerated Learning’ (Clay, 2005) to bring students to a level that enables them to function independently in the classroom and gives them the skills to overcome the gaps in their emerging literacy skill repertoire.
Values and aims:
Problem Solving, Proficiency, Flexibilty, Independence and Fluency

[PK] - Pedagogy Knowledge (Reading Recovery Inspired Procedures). Table 2.2

Pedagogy and the methods inspired by and adapted from (Clay, 2002; 2005a) (Goodman, 1987)

'Familiar Reading' A method to help the student trigger prior knowledge and to begin the information processing faculties within a lesson.
'**Running Record on a New Book'** Allows the child to demonstrate a reconstruction of the new information from a previous lesson. It determines and provides evidence of potential growth as determined through the child's problem solving with an instructor, while reading continuous text (Clay, 2002).
'Letter and Word Work' Supports the child in processing information with respect to common and familiar letter combinations. It is a visual exercise that encourages quick processing. This is a key formative skill in latter problem solving opportunities. With adult supervision and guidance, activities are designed to teach new patterns, reinforce old patterns or provide additional opportunities to make certain combinations 'known' (Clay 2005). See Figures 6. to 16.
'New Text' The selection of a new book is a challenge as the adult activates all he/she knows about the child's present level of reading, interests, linguistic schema and vocabulary. This process entails a very high level of intersubjectivity, as the adult essentially becomes a representation of that child and all that he knows or doesn't know about reading. This helps to narrow the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. Vygotsky's description provides a clear representation of something that teachers do numerous times every day as they become aware of the child's semiotic understanding, symbolic knowledge, and linguistic functioning. (Vygotsky 1978)

[TK] - Technological Knowledge. Table 3.0

Technology knowledge [TK] is knowledge about standard technologies:
Computer, Peripherals, Mouse, Pen, SMART Sympodium DT 770, Notebook Software
This involves the skills required to operate particular technologies:
Hardware setup and accessibility to student
Ability to use standard sets of software tools:
Word Processors, Draw Environments, Word to Speech, Digital Recording Devices
The ability to learn and adapt to new technologies:
Adaptive and Routine Expert Research
Further Description of Interactive Technologies (FITS), TPCK Framework

With interactive technologies, the student has the ability to use the sense of touch. This enables the student to use tactile and kinesthetic motor actions. Digital technologies can record and play back sounds to support learning through the auditory modality. Interactive digital technologies can also enhance visual information. (Anderson-Inman and Reinking cited in NCREL 2005). In effect, the SMART Sympodium provides the student with the capacity to activate and use the information gained through these three major modalities to impact on his or her learning. Through the use of digital technologies and their inherent ability to store and retrieve documents instantly (ILEA, 1995), the teacher can call up: student work, archived lessons and saved instructional records. The quick and ready access to the current lesson, as well as the ability to call up any archived lessons, can help to activate a student's memory and prior knowledge. Additionally, some of the principles of early literacy, e.g. directionality can be demonstrated using interactive software tools. Furthermore, by using the 'Show/Hide Screen Shade' tool, a teacher can easily illustrate the left to right directionality of English language text (Figures 11., 12., and 30.).

[TPCK] - Technological Knowledge. Table 4.0

Linking CPK, TCK, and TPK,
In addition to the three discrete previously mentioned types of knowledge there is also overlap between them to create a collaborative and nuanced knowledge that is demonstrated by an informed practitioner. These relationships will be addressed in the post intervention phase.

Methodology

Table 5.0

Participants.

Two students have been selected from *inner city school* during this investigation. They will be identified by the pseudonyms, B.B. and D. D.

Student / Activity	Case Study 1 Student B.B.	Case Study 2 Student D.D.
Description	B.B. is a 7 year old boy, in Grade Two, who is working at the lowest level within in his grade and age grouping in the area of reading.	D.D. is a 10 year old boy, in Grade Five, who is reading considerably below the grade level group norms.
Timeframe of Inquiry (Dates Administered)	September 2008 to February 2009 Alternate daily sessions. This inquiry was conducted over a period of approximately 20 weeks in my role as Reading Intervention Specialist.	March 2009 to June 2009 Alternate daily sessions. This inquiry was conducted over a period of approximately 12 weeks in my role as Reading Intervention Specialist.
Collection - Baseline Data	September 2008 Diagnostic Language Assessment Teacher Survey Student Survey Parent Discussion (Appendix A)	March 2009 Diagnostic Language Assessment Teacher Survey Student Survey Parent Discussion (Appendix A)
Implementing Intervention Program	Direct Instruction and Intervention Phase – Sept. 2008 to February 2009 Observations of Student Activity during the Inquiry	Direct Instruction and Intervention Phase – March 2008 to June 2009 Observations of Student Activity during the Inquiry
Analysis - Inquiry/Research Student One (See Appendix B)	Examining the various evidences – February 2009 Teacher Survey Student Survey (Appendix B) Lesson Artifacts Retrieved from Digital Repository (See Page 13) Auditory Samples – (Appendix	Examining the various evidences – July 2009 Teacher Survey Student Survey (Appendix B) Lesson Artifacts Retrieved from Digital Repository (See Page 13) Auditory Sample – (Appendix

	C) Field Notes Interviews Post Intervention Information – March 2009	C) Field Notes Interviews Post Intervention Information – July 2009
Write up of the Inquiry/Research Student One	Final Write Up and Submission – Summer 2009	Final Write Up and Submission – Summer 2009

Index of Figures

Table 6.0

The Learning Space.

Figures 2. and 3. Actual photographs of B.B. (wearing a glove) manipulating the screen in an alphabetic activity. He the makes use of visual, auditory and tactile information.

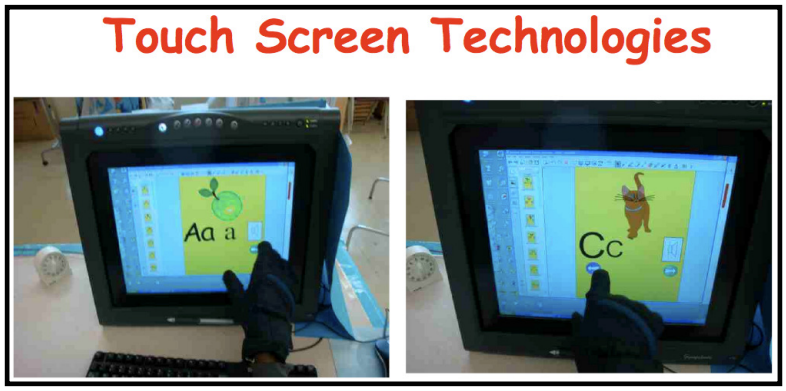

Figure 2.

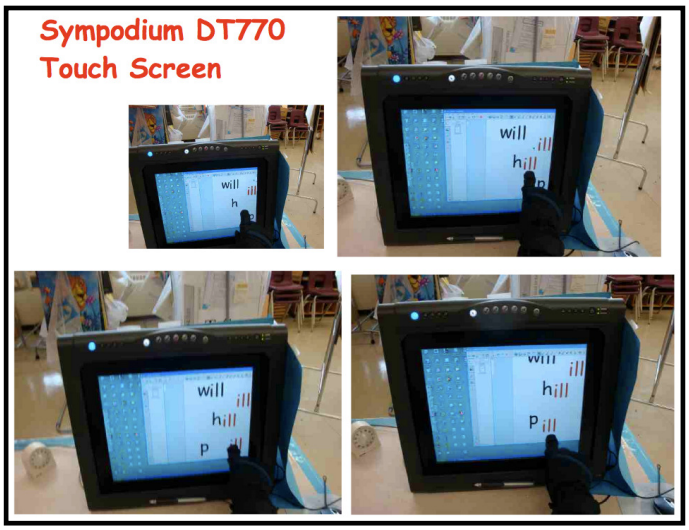

Figure 3.

Figures 4. and 5. Photos of the learning space: The left hand side is focused on print-centred resources and the right hand side in focused on screen-centred resources.

Print-centred Learning Space

Figure 4.

Screen-centred Learning Space

Figure 5.

Lesson Artifacts Retrieval from Digital Repository

Figure 5. SMART online resources provide a repository of engaging lessons that can incorporate sound, colour and animation affects (http://education.smarttech.com/ste/en-US/Ed+Resource/) .

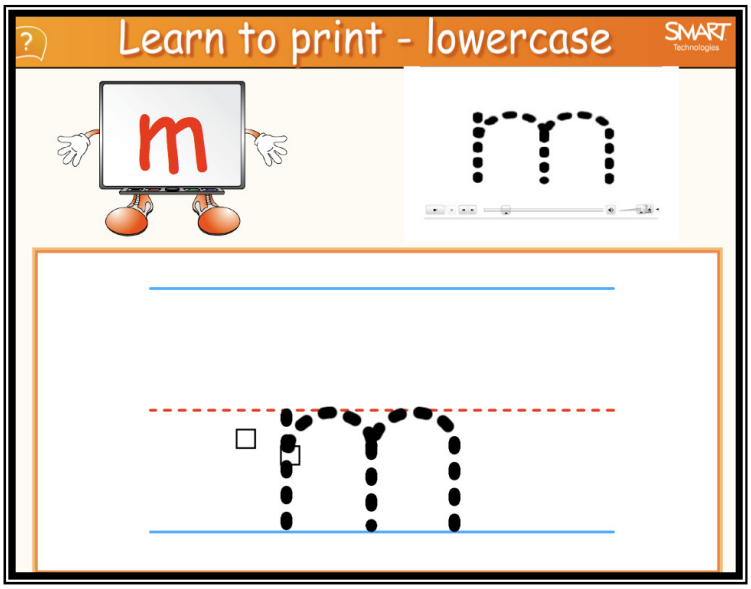

Figure 6.

Figure 6. SMART Notebook software enables the teacher to create engaging, interactive lessons. This personalized alphabet book had sound and touch screen capabilities.
Figure 7. Students can choose the figure and background colours. This is in keeping with Erlin's work with colour-based technology interventions. The teacher recorded phonemic sounds for each letter of the alphabet and then linked them to each respective letter (Fig.8 has black text (figure) and green background (ground).

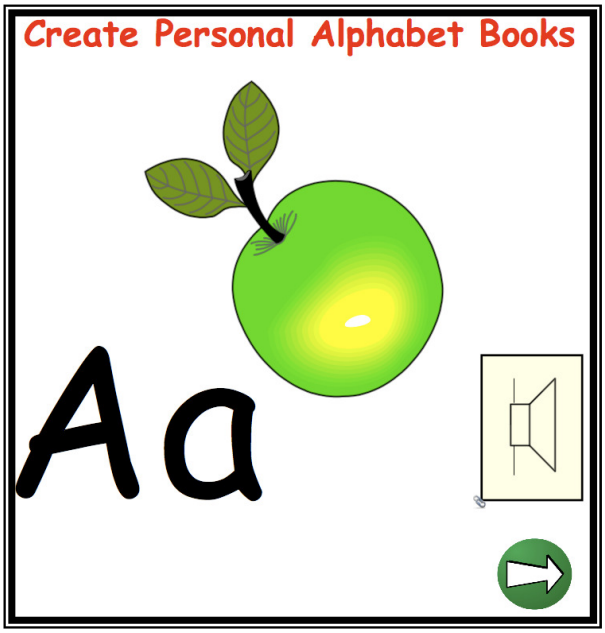

Figure 7.

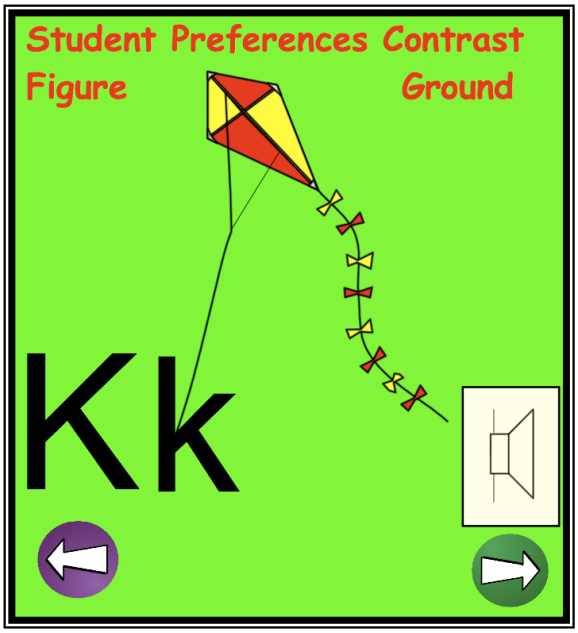

Figure 8.

Figures 9. and 10. Using the 'ay' rhyme ending, students are able to 'break' words into familiar patterns and use them to create and learn new words.

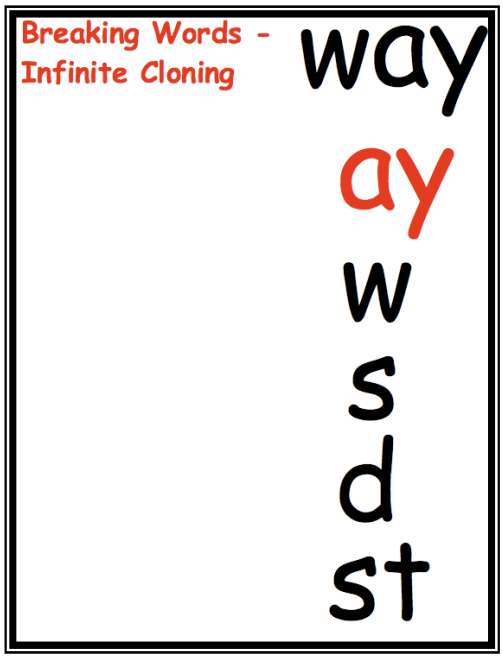

Figure 9.

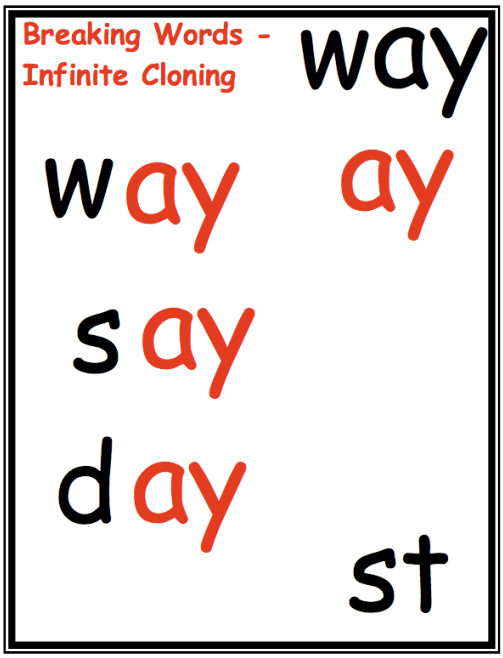

Figure 10.

Figures 11. and 12. The use of the Screen Shade tool allows the teacher to introduce and reveal concepts in a deliberate manner. While introducing concepts the teacher can guide or control the movement of the student's eye to develop efficient 'strategic activity' on print.

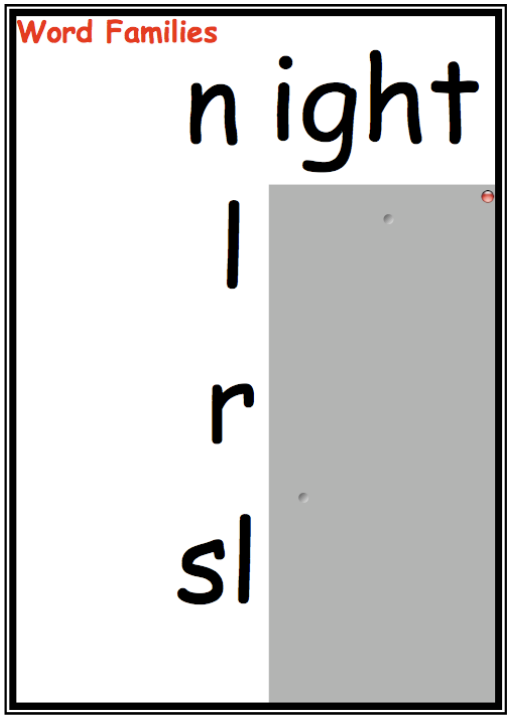

Figure 11.

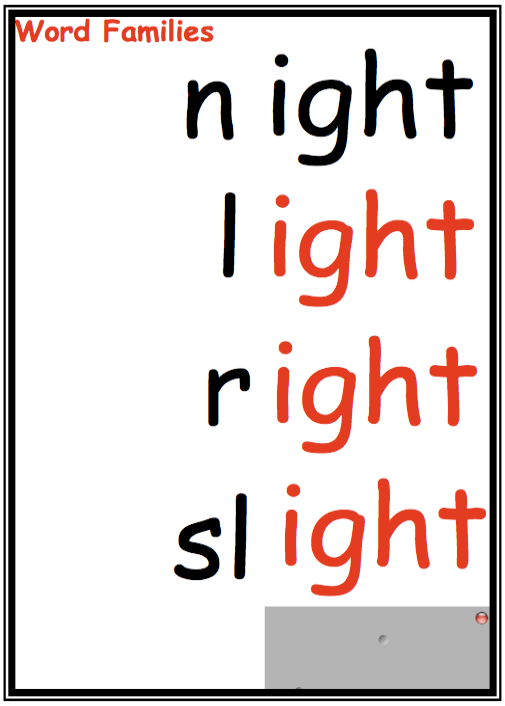

Figure 12.

Figures 13. and 14. By unlocking the text objects ‘sm’ and ‘ell’ from his ‘known’ words ‘small’ and ‘well’, student is able to ‘get’ to the unknown word, ‘smell’ (Kaye, 2008).

Figure 13.

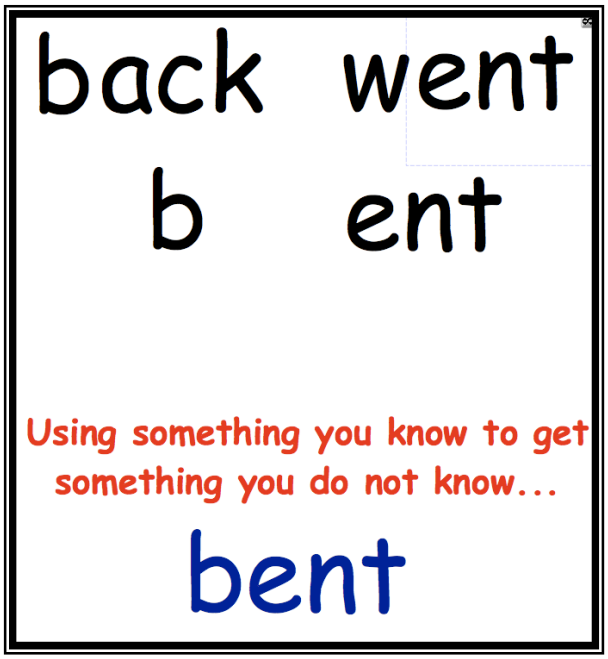

Figure 14.

Figure 15. and 16. Using a passage from a text, teacher can pull out information from context (text), create a ‘word study’ lesson, and then put it back into context. Figure 16. Illustrates the combination of ‘figure ground’ colour sensitivity and annotation capabilities of pen technologies.

Figure 15.

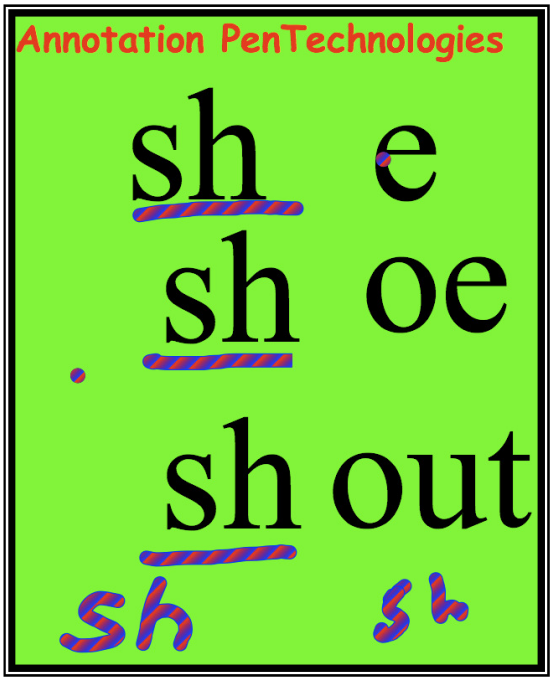

Figure 16.

Figures 17. and 18. By creating the ‘ing’ text object with a solid white background student can slide over the inflection to cover up the ‘e’ and create the participle ‘hiding’.

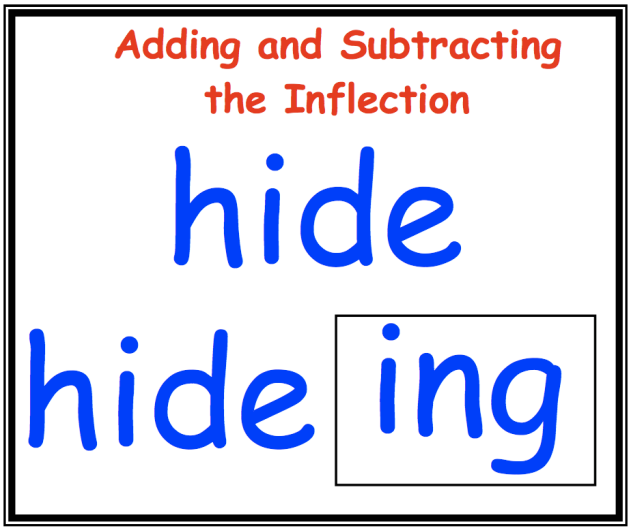

Figure 17.

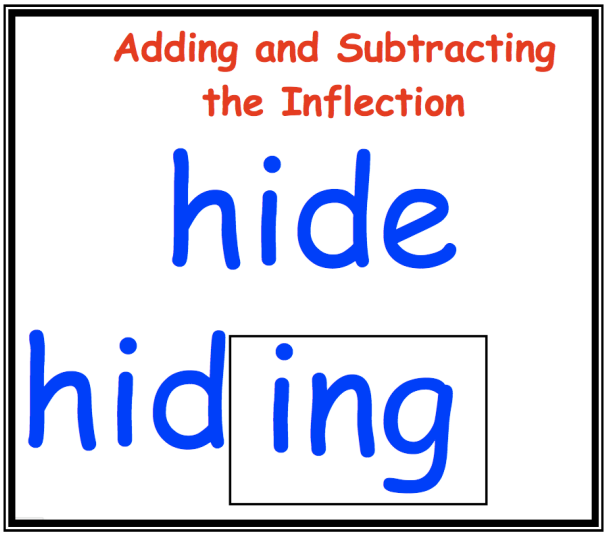

Figure 18.

Figure 19. Plural forms can be annotated and highlighted by the student using the pen tools.
Figure 20. Working with contractions is made easy by creating a text object, with a white background for the apostrophe and dragging it to obscure a disappearing letter.

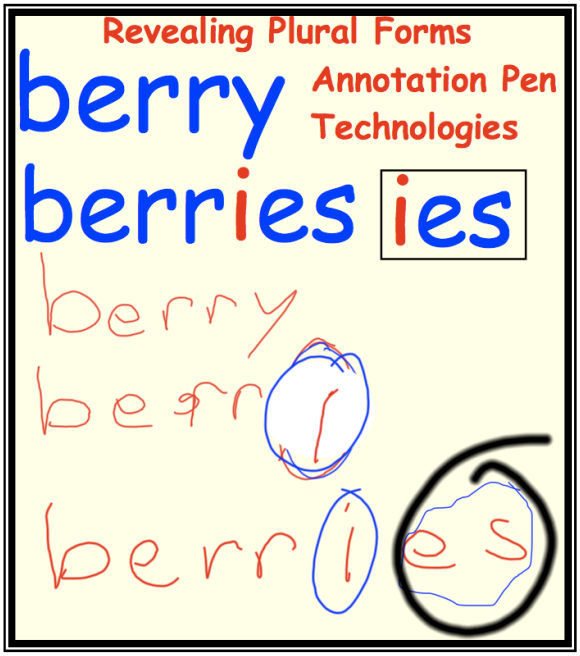

Figure 19.

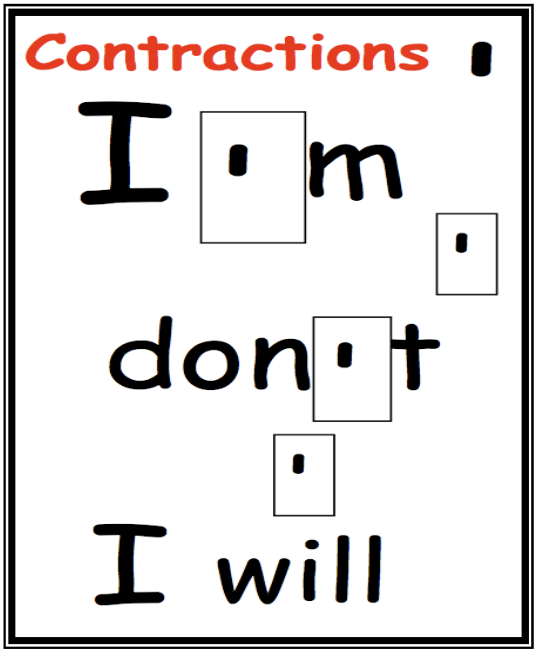

Figure 20.

Figure 21. and 22. Each of these die can be animated to create a plethora of Consonant Vowel Consonant [CVC] word structures. These animations can help students use visual sources of information, i.e. sounds (phonemes) and letters (graphemes), to process and read CVC words in a quicker manner.

Figure 21.

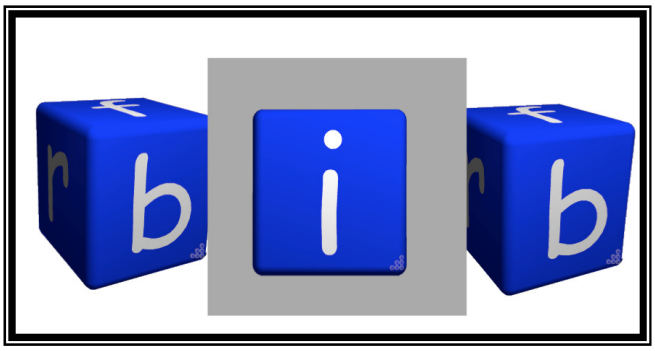

Figure 22.

Figures 23., 24., and 25. Teacher can create and input regular or irregular letter combinations to support the recognition of the 'rhyme', i.e., the combination of letters at the end of the word. This animation tool is a very engaging activity for students.

Figure 23.

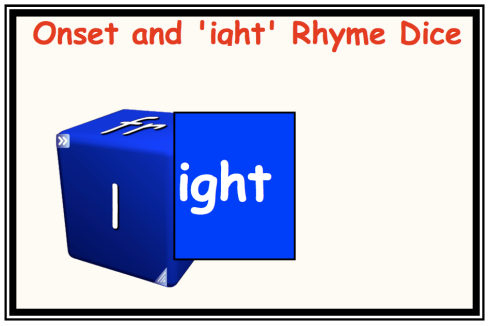

Figure 24.

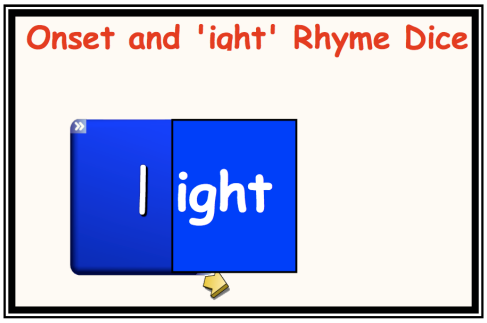

Figure 25.

Figure 26., 27., 28. and 29.
Infinite cloning to support work related to onset and rhyme. Figure 29. focuses on different endings.

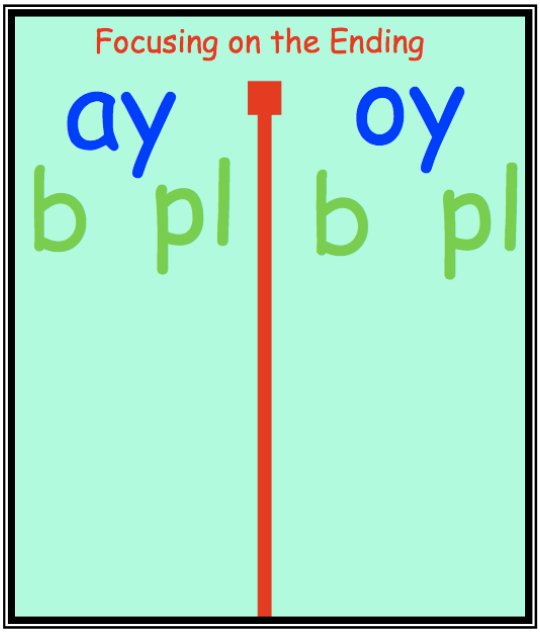

Figure 26.

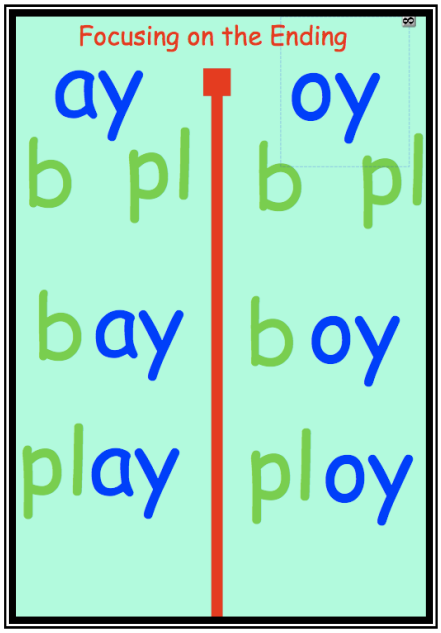

Figure 27.

Figure 28.

Figure 29.

Figure 30. The use of Notebook's Screen Shade tool (grey rectangle) can help left to right tracking. By slowly dragging the tool from left to right the teacher can help direct the student's eye(s).

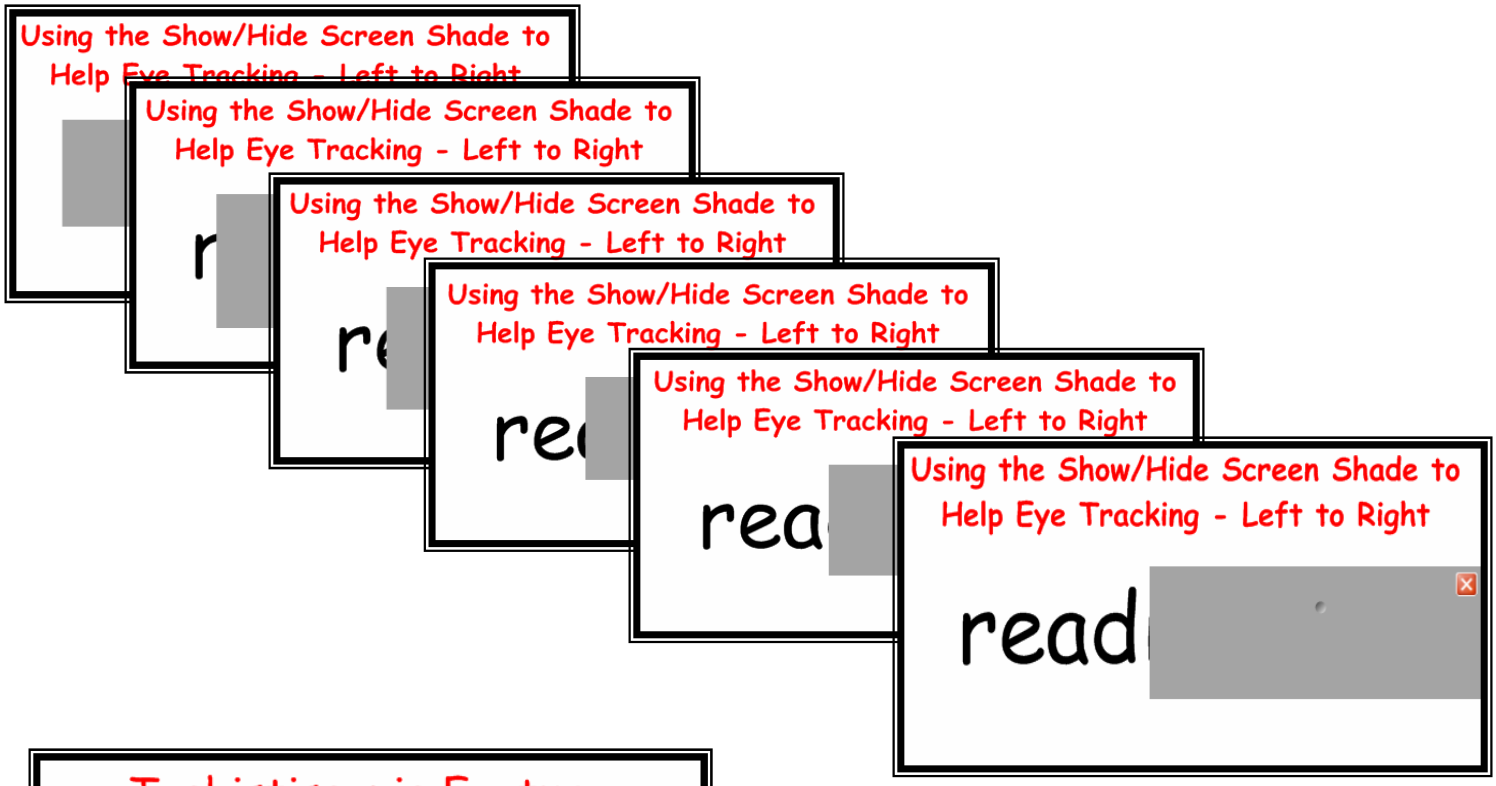

Figure 30.

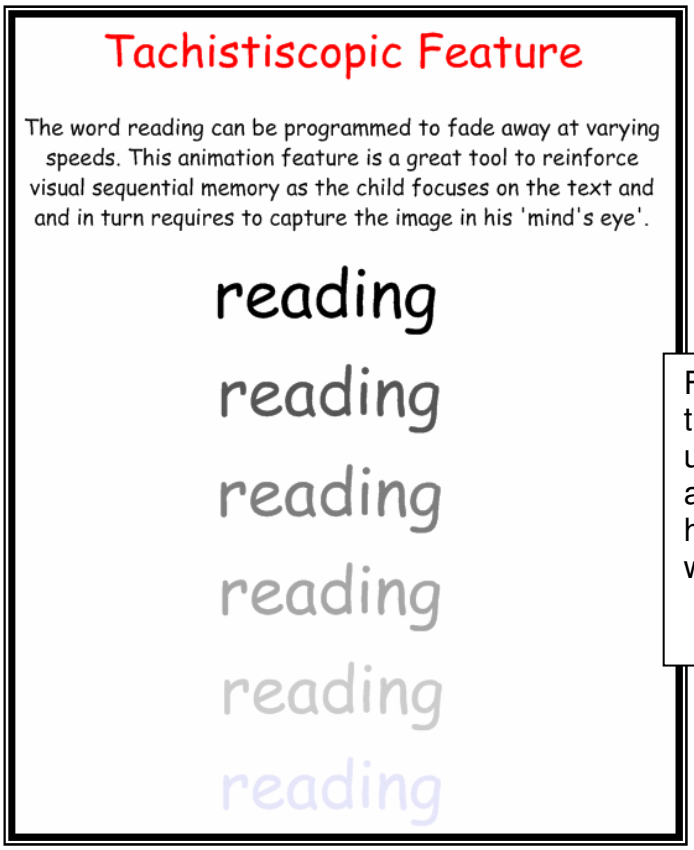

Figure 31. Through the use of Notebook's transparency features the teacher can set up an animation whereby a word can fade in and out. This can help the child to develop his or her visual sequential memory as the word disappears in front of the eye.

Figure 31.

Explorations with Text in Context (Reading 'Continuous Text')

Figure 32. The circular spotlight tool can be used to focus in on punctuation.

Figure 33. The software provides us with the ability to annotate and teach directly onto the text. Once again the student sees the text deconstructed and annotated in context.

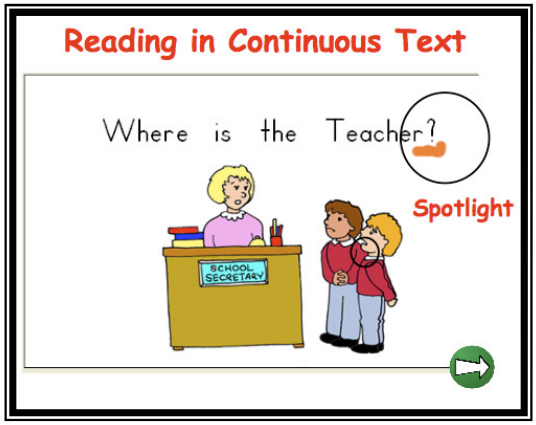

Figure 32.

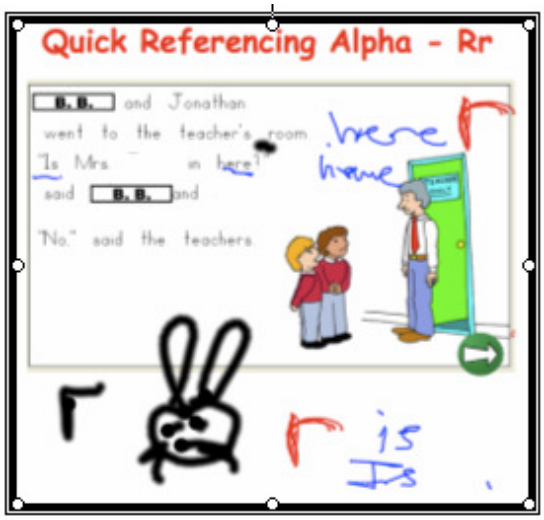

Figure 33.

This electronic book has been adapted to support and enhance B.B.'s reading activity. Electronic Books have been adapted from:

Bookbuilders, Pioneer Valley Books, (2004). Bookbuilders Software, Distributed by Literacy Footprints.

Figure 34., 35., and 36. Students can choose the figure and background colours. This is in keeping with Erlin's work with colour-based technology interventions. In this example, the student was provided with a choice of 3 pre-selected combinations. D.D. chose Figure 36, a turquoise background and a dark blue text colour as his preferred colour-based arrangement.

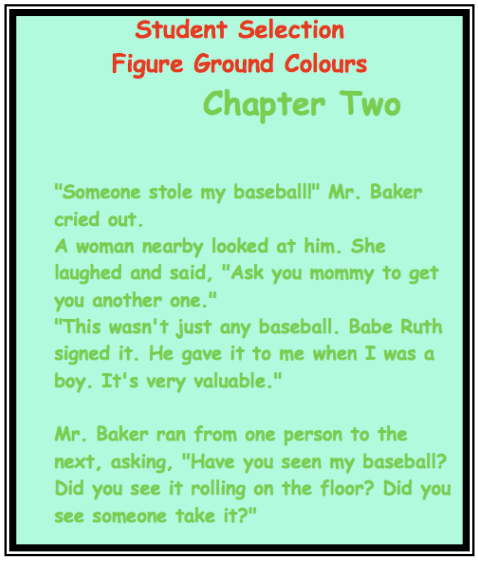

Figure 34.
Green Text on Turquoise Ground

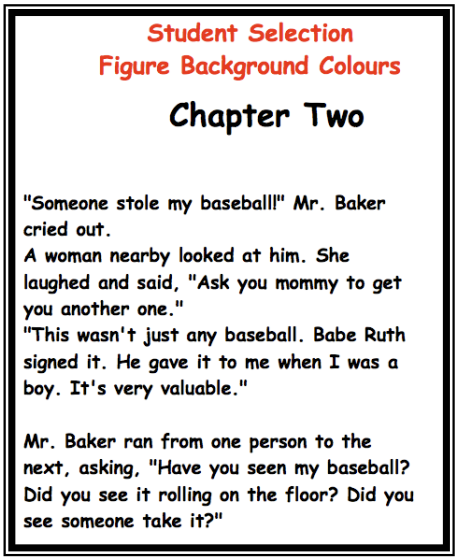

Figure 35.
Black Text on White Ground

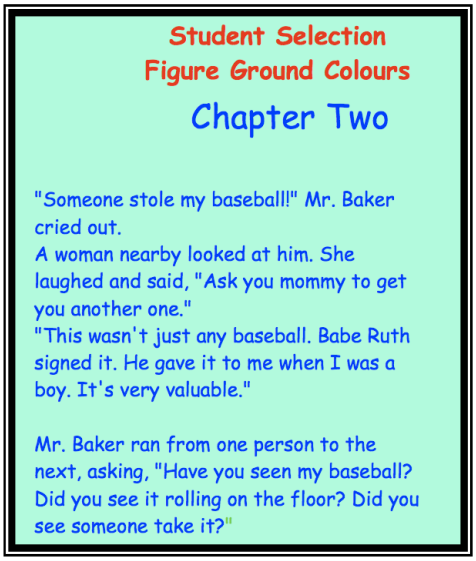

Figure 36.
Blue Text on Turquoise Ground

Figures 37., 38., and 39. The software provides us with the ability to annotate and teach directly onto the document. Once again the student sees the text deconstructed in context. The software allows us to create an activity that provides the student with a practice and application activity to reinforce the learning of a variety of text features. (Text from, *Cam Jansen, The Mystery of the Babe Ruth Baseball*, Adler, D., Puffin Books, 2004).

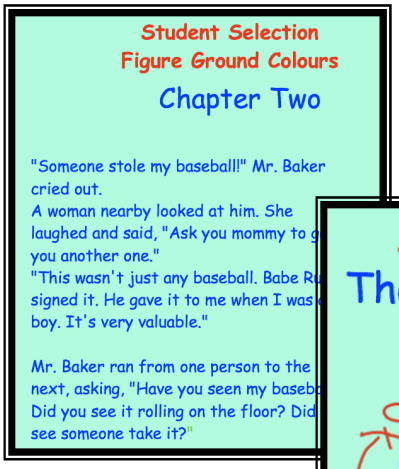

Figure 37.
Blue Print on Turquoise Ground and with Red Annotation

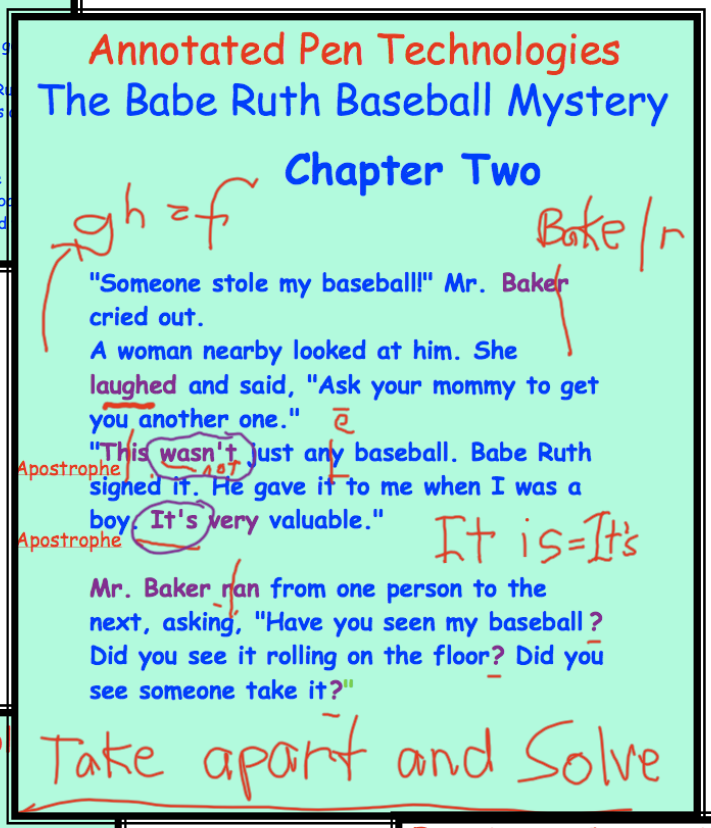

Figure 38.
Blue Print on Tourquoise Ground with Red Annotation Markings

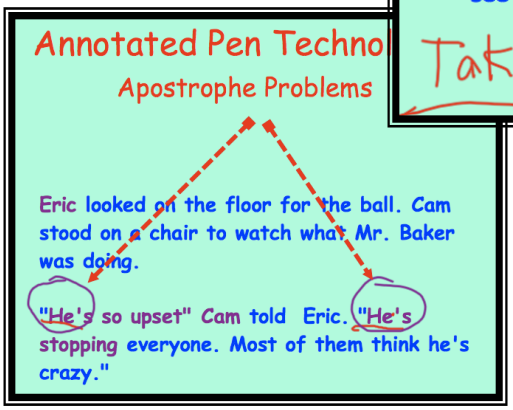

Figure 39.
Blue Print on Turquoise Ground

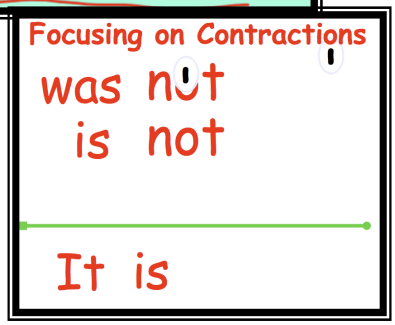

Figure 40.
Red Print on White Ground

Figure 41., 42., and 43. Some writing passages have a considerable number of contractions. Annotating the page can help students recognize and focus in on these constructions. In turn we can use Notebook software to 'tailor' lessons to support the understanding of contractions. In Figure 42., we have used an apostrophe 'object' with a white background to obscure the missing letter(s) in the contraction. (Text from, *Cam Jansen,The Mystery of the Babe Ruth Baseball,* Adler, D., Puffin Books, 2004.)

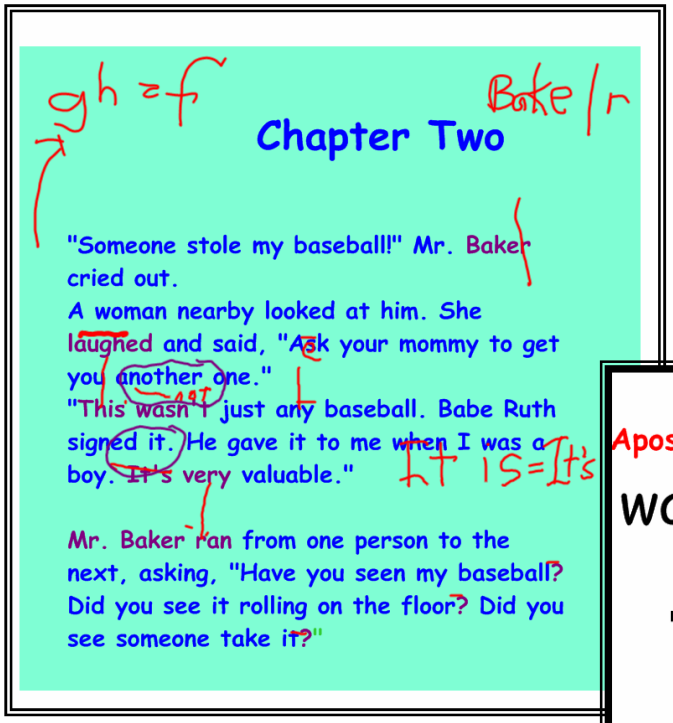

Figure 41.

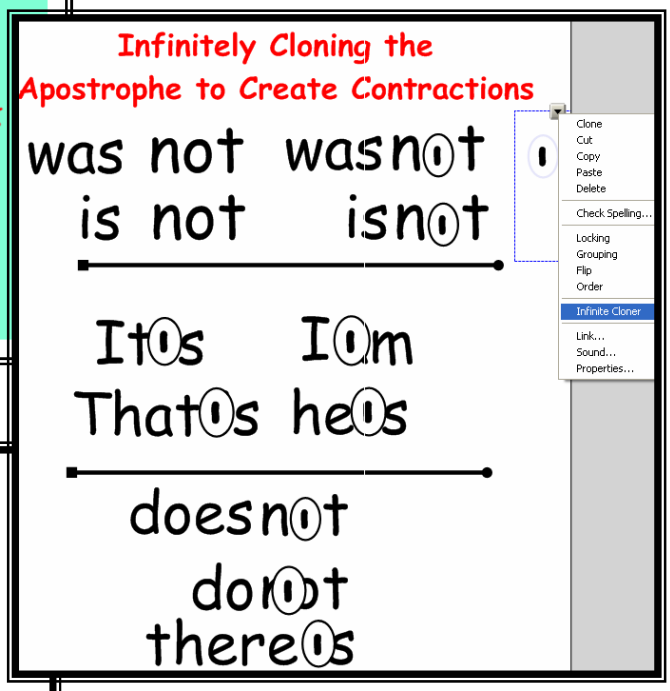

Figure 42.

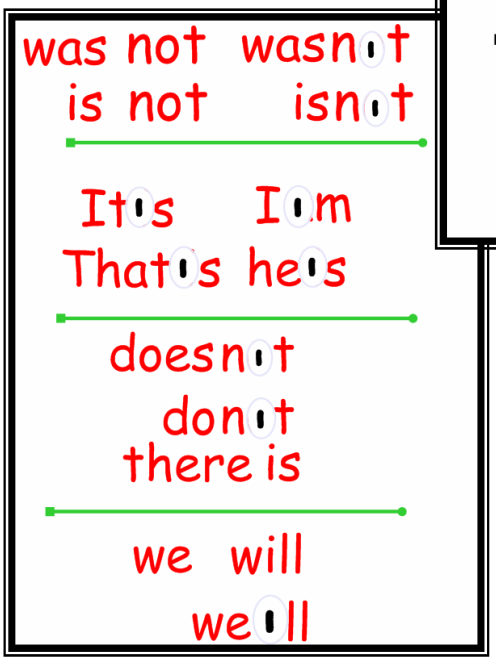

Figure 43.

Figure 44. The Notebook software provides us with the ability to annotate and teach directly onto the text. Here D.D. can work on punctuation to help him read with greater fluency and meaning. (Text from, *Cam Jansen, The Mystery or the Babe Ruth Baseball,* Adler, D., 1982

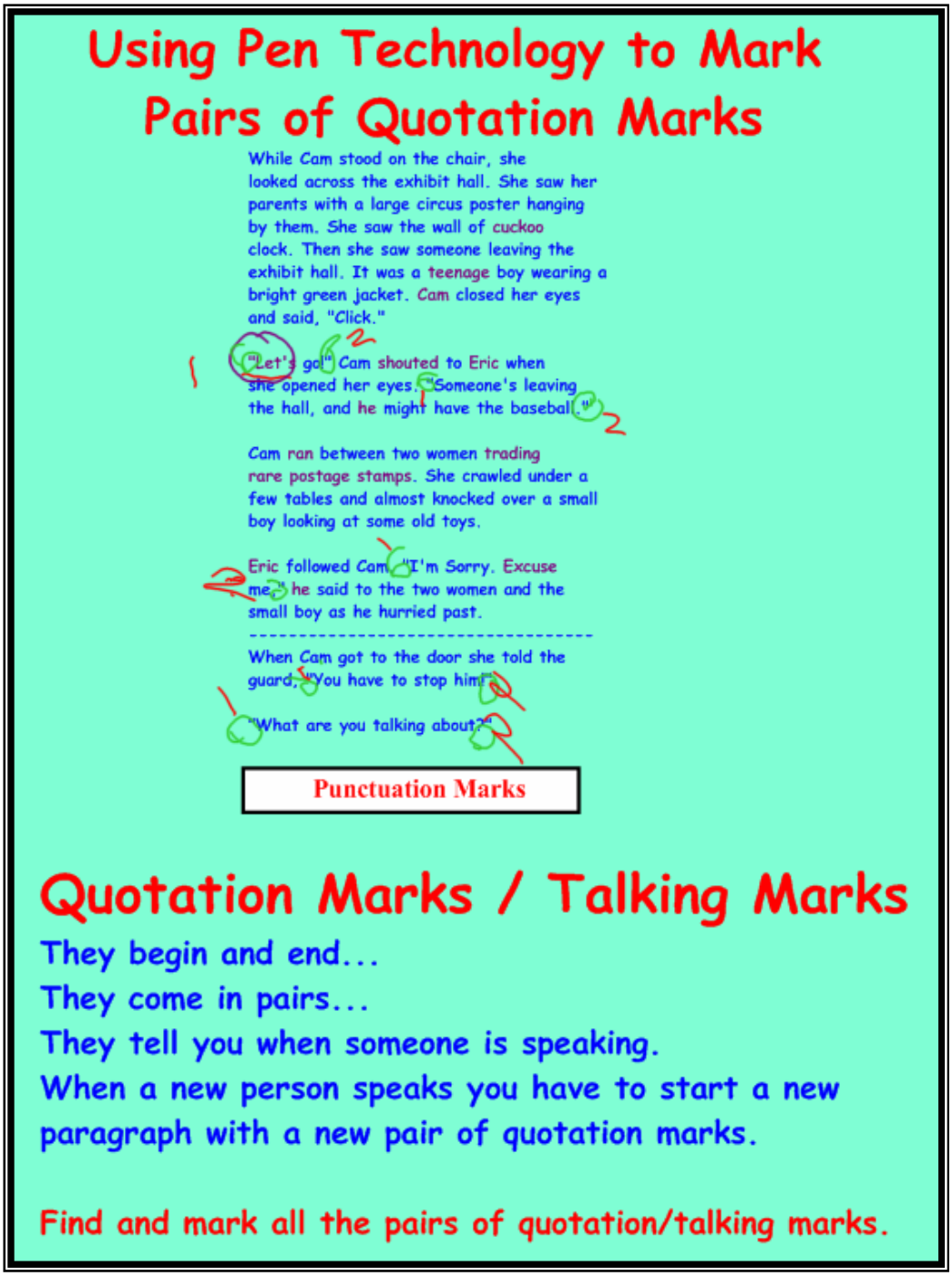

Figure 44

Figures 45. and 46. Once again pen annotation tools help us to break up words into effective parts in order to read more effectively. See also Figures 9. and 10.

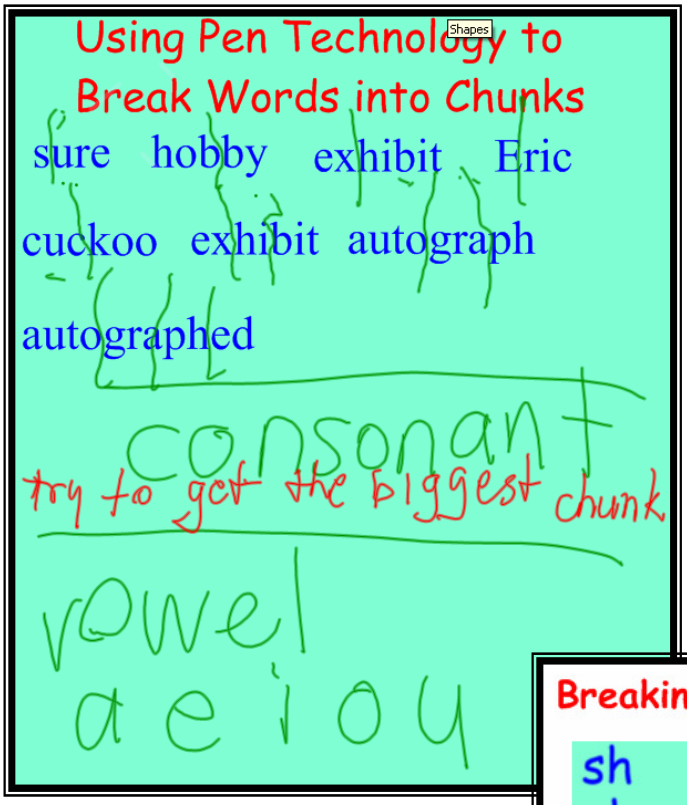

Figure 45.

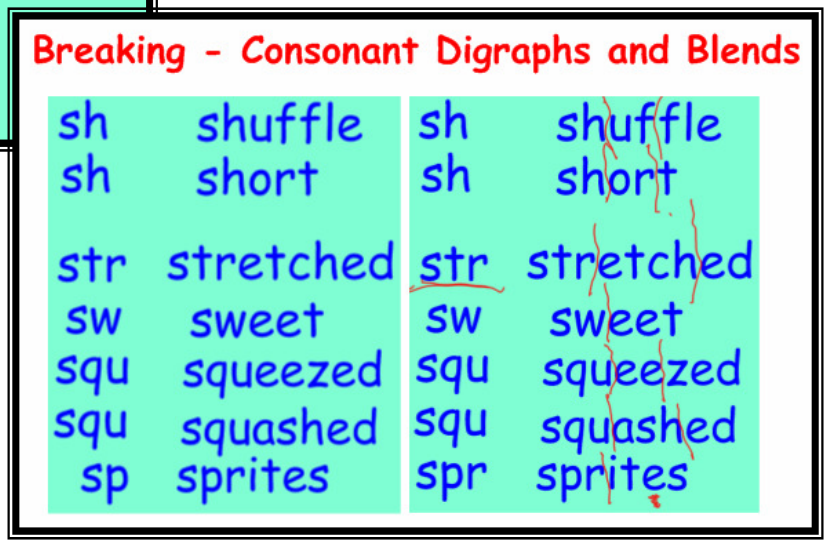

Figure 46.

Figure 46. Teacher and student can develop word analysis skills using Notebook software to focus on consonant blends and digraphs.

Figures 47., 48., 49., and 50. Using the draw environment of Notebook software, student can brainstorm ideas onto the screen and then sort them by meaning or other characteristics. The touch screen interface of Notebook software allows for easy clicking and dragging of each word or concept using one's finger or a pen.

Figure 47.

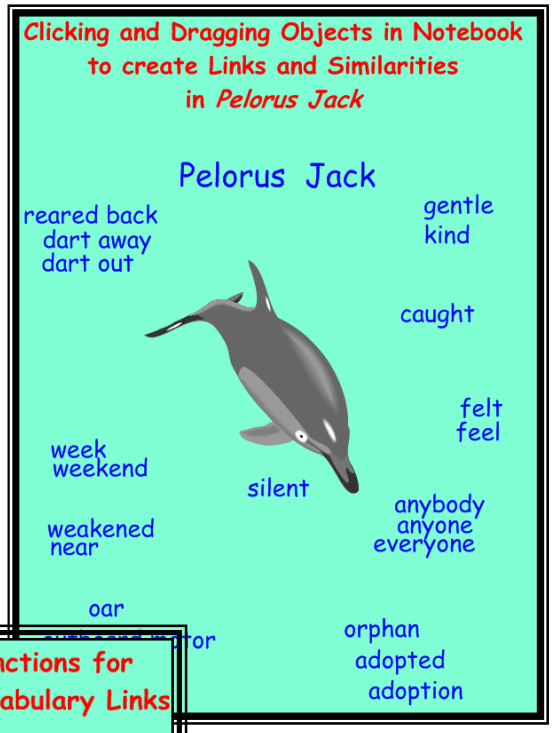

Figure 48.

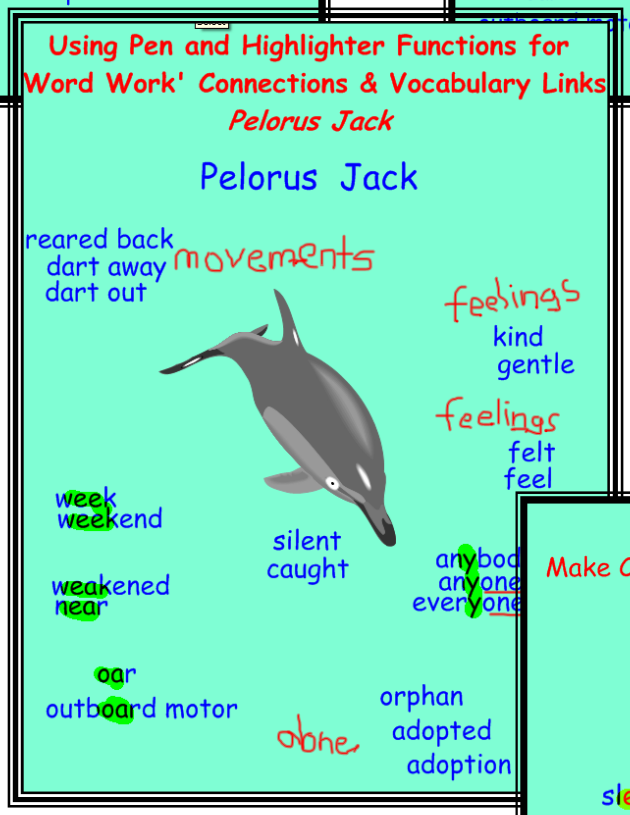

Figure 49.

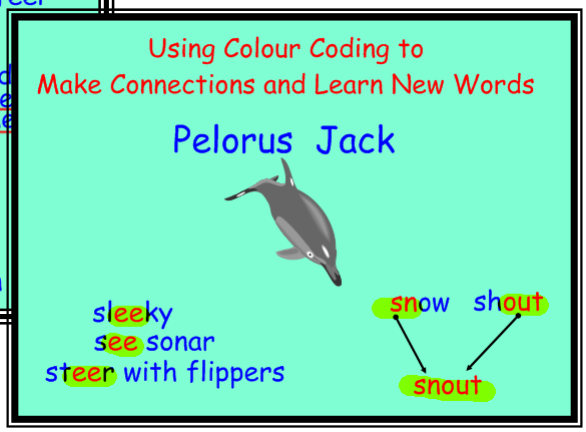

Figure 50.

Figures 51., 52., 53., and 54. Using the infinite cloning feature, the student can create as many words out of Dolphin as possible. Figure 51. demonstrates how to activate the infinite cloning feature. Once cloning is activated, the student can pull down as many copies of that letter as needed (see Figure 51 and the Letter 'B').

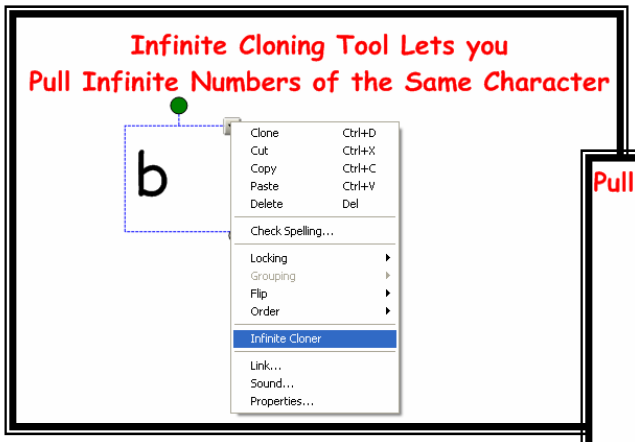

Figure 51.

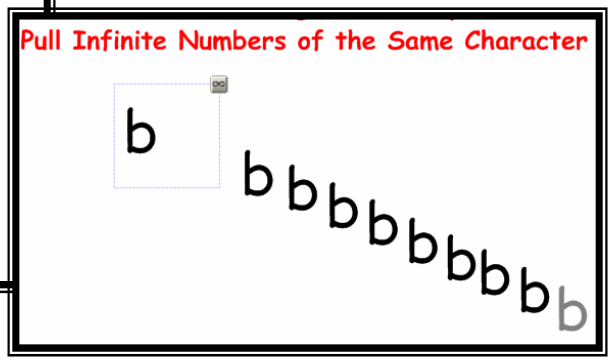

Figure 52.

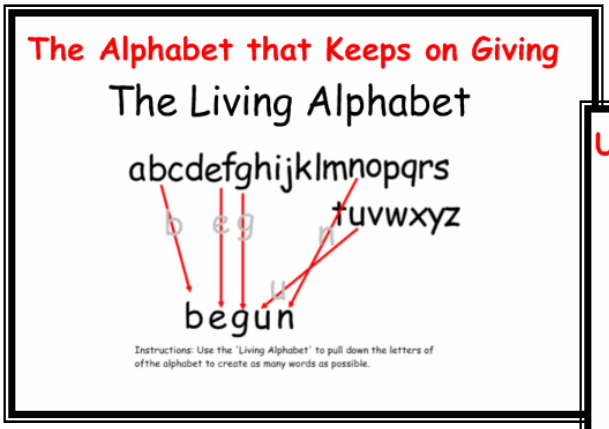

Figure 53.

Figure 53. Teacher created the 'Living Alphabet' and the student was able to pull down any letter to create a new word. In Figure 54., the Living Alphabet is used for the word dolphin and the student, D.D., was able to create as many words as possible. Using this activity he was able to build his vocabulary while reading a story about Pelorus Jack, a dolphin.

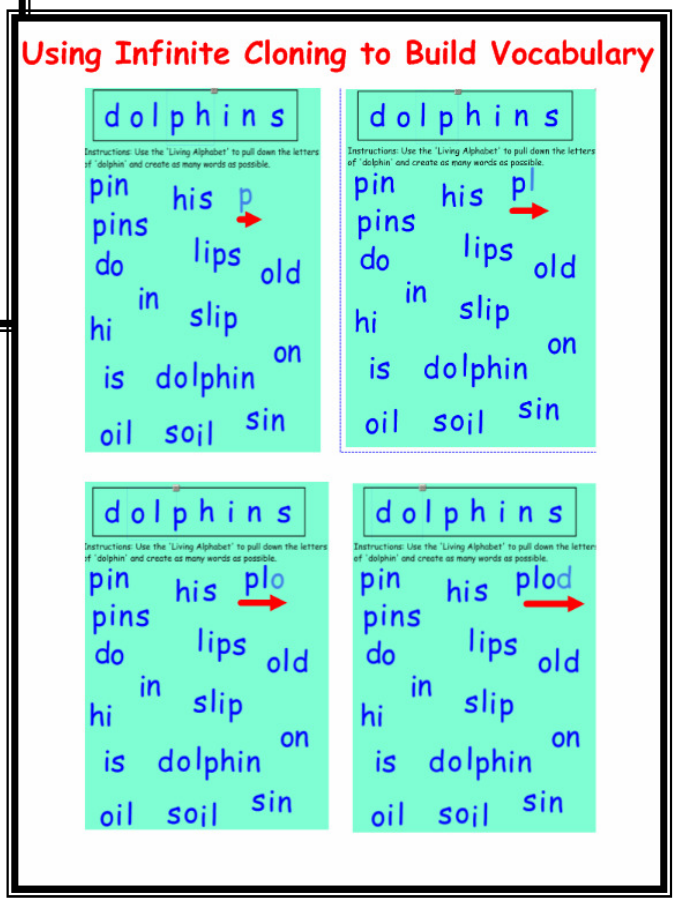

Figure 54.

Shining Additional Light on the TPCK Model

Linking Pedagogy and Content Knowledge [PCK].

In addition to the discrete components of the TPCK, there is also an overlap between them to create a collaborative knowledge. By shining a light on the TPCK framework, I will now try to address the intersection sets of the model.

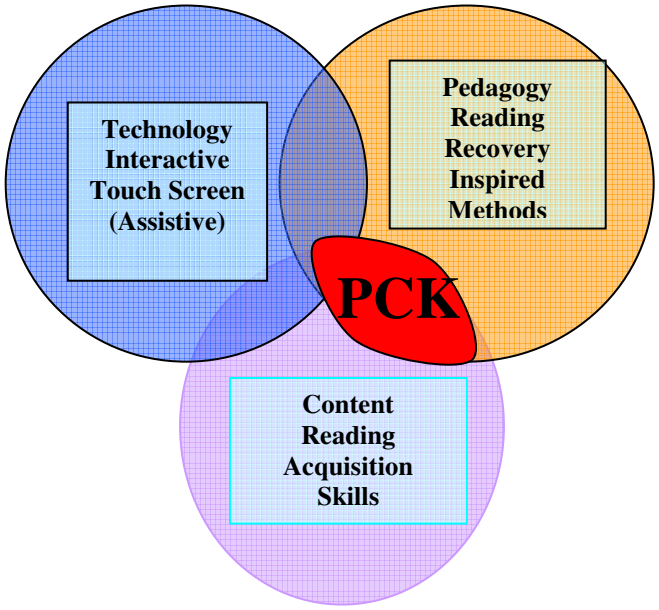

Figure 55.

This knowledge includes knowing what teaching approaches fit the content, and likewise, knowing how elements of the content can be arranged for better teaching. PCK is concerned with the representation and formulation of concepts, pedagogical techniques, knowledge of what makes concepts difficult or easy to learn, knowledge of students' prior knowledge. It also involves knowledge of teaching strategies that incorporate appropriate conceptual representations in order to address learner difficulties and misconceptions and foster meaningful understanding (Mishra & Koehler, 2006, p 1026).

Using the aforementioned description, we can apply these elements of the model to our own specific FITS scenario. Marie Clay describes children who are struggling, with reading, as children who are using problematic strategies. Problems can occur when students have difficulty with the direction, sequence and orientation of print (Clay 2005a). Analyzing difficulties allows the teacher to help the student develop strategies to see information accurately and analyze print strategically. Figure 30. helps the learner track print sequentially. Once problems are identified, students can be instructed to process information accurately and efficiently. Dealing with these problems and 'misconceptions' will provide students with the skills to use all the main sources of getting information from the page of text: visual, structural and meaning. (Clay, 2005a)
In addition, throughout the lessons, diagnostic and formative assessment techniques are used to address learner difficulties and 'misconceptions' with content. Once students are able to use all sources of information in an efficient and accurate manner, they are able to accelerate their progress and achievement in reading.

'Linking Technological and Pedagogy Knowledge [TPK].

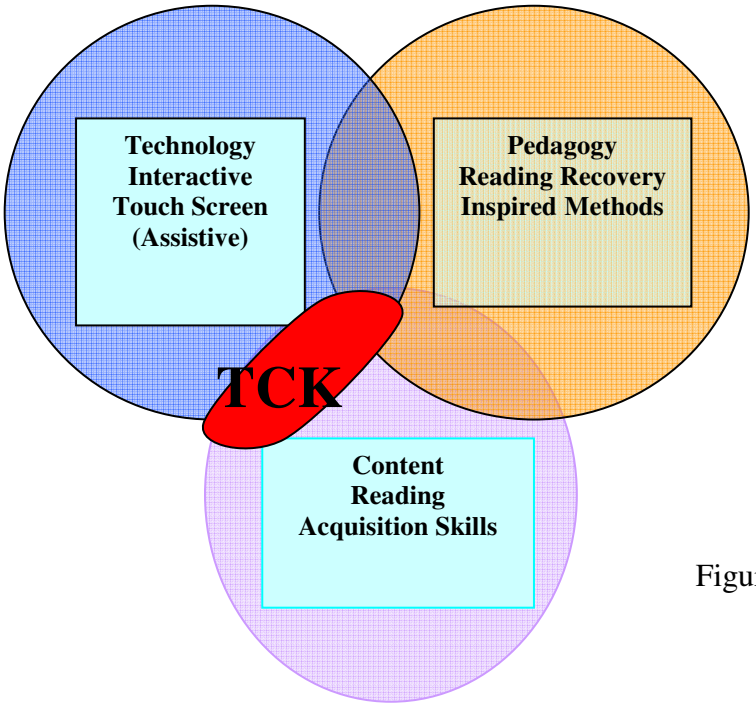

Figure 56.

> Newer technologies often afford newer and more varied representations and greater flexibility in navigating across these representations. Teachers need to know not just the subject matter they teach but also the manner in which the subject matter can be changed by the application of technology. However, the computer program does more than that. By allowing students to "play" with geometrical constructions, it also changes the nature of learning geometry itself; proofs by construction are a form of representation in mathematics that was not available prior to this technology. Similar arguments can be made for a range of other software products (Mishra & Koehler, 2006, p. 1027).

SMART Notebook Software can emulate some of the strategies that are employed in a Reading Recovery inspired lesson. However the use of Notebook software program changes the nature of the reading process due to the application of technology. The resources inherent in the software: window shade, spy glass, infinite cloning and animations tools change the nature in which the subject is taught, e.g., Figures 21. to 25. allow for the construction of 'CVC' words in a dynamic, game-like, screen environment. The nature of digital ink and software animation capabilities modify the textuality of print and provide for a different experience while learning.

These resources allow students to "play" with constructions. Some resources are not available to students for home use, e.g. magnetic letters. Taking magnetic letters home is not generally an option for students. However students can easily transport the lesson components in a digital form. Using a USB key, all these lessons are available for home use (Figures 6. to 29). The 'living alphabet' would be an ideal resource to replicate the educational uses of magnetic letters (Figure 53.).

Linking Technological Content Knowledge [TCK].

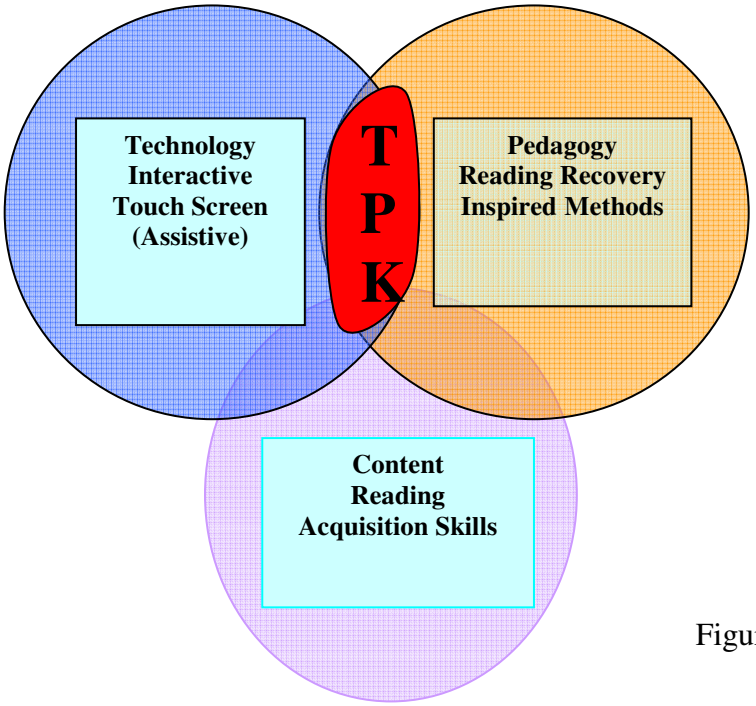

Figure 57.

> Technological pedagogical knowledge [TPK] is knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as the result of using particular technologies. This might include an understanding that a range of tools exists for a particular task, the ability to choose a tool based on its fitness, strategies for using the tool's affordances, and knowledge of pedagogical strategies and the ability to apply those strategies for use of technologies (Mishra & Koehler, 2006, p 1027).

Using the aforementioned description, we can apply the terminology to our own specific FITS scenario. Over the course of this study I have been exploring effective ways of applying hardware and software, specifically the Sympodium DT 770 and Notebook Software, to teach reading content and literacy skills. I have had to understand the range of tools that exist for a particular task and have had to learn how to best represent the task on the screen, For example, Figures 9. and 10. use the infinite cloning tool to help with onset and rhyme. Figures 53. and 54. use the cloning tool for word study and vocabulary building. I have had to be cognizant of learning theories and I have needed to apply them to the technological context afforded to me, i.e., adapting what I know about using visual, auditory and tactile modalities in the context of the technology. Figures 7. and 8. demonstrate multimodality teaching and learning using a multimedia, [visual, auditory, and tactile] alphabet book.

Linking Pedagogical Technological Content Knowledge TPK.

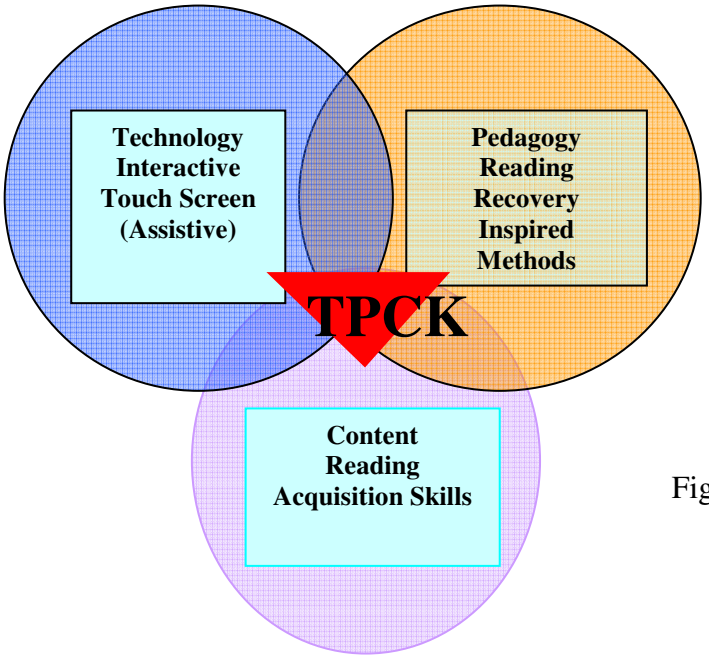

Figure 58.

Mishra and Koehler are sensitive to the fact that in a complex, multifaceted, and ill-structured domain such as integration of technology in education, no single framework tells the "complete story"; no single framework can provide all the answers. The TPCK framework is no exception. However, we do believe that any framework, however impoverished, is better than no framework at all (Mishra & Koehler, 2006, p. 1042).

TPCK can be a basis for beginning a positive discourse around good teaching with technology. The FITS study has provided me with the opportunity to weave these three subsystems together. I have tried to incorporate the reading content skills with a Reading Recovery inspired method in order to accelerate the acquisition of literary skills. I have tried to incorporate reading content skills with interactive technologies in order to make reading skills more accessible to students through screen-centred environments. I have tried to incorporate interactive technologies with Reading Recovery inspired approaches in order to make them more compelling to students. Finally, I have tried, with the use of the TPCK model, to mesh interactive technologies, with Reading Recovery inspired pedagogy, to accelerate the acquisition of reading skills and emerging literacy skills.

How well these three components come together in a dynamic and authentic teaching situation is crucial. Can the technology be activated instantly, during a lesson, to support a student's learning in a subject? Can the teacher create activities, on the fly, to address an area of weakness? In response to this, I was pleasantly surprised to discover the ease with which I was able to create lessons on a need basis. The ability to activate all three elements within a dynamic teaching setting is encouraging. How well the combination of these three components mesh together will determine the effectiveness and responsiveness of this and any other future technology.

Observations/Findings

The Potential to 'Do Different Things'

> I like to distinguish between "doing things differently" and "doing different things". The first describes incremental improvements in tasks that can be facilitated with new equipment, but the end result is pretty much the same as what was created with the previous generation of the tool…A brand new task (cutting a music CD, for example) was impossible thirty years ago, and if this is a task you want to perform, then somewhere along the line you need to upgrade your hardware. (Thornburg 2002, para. 6)

One of the fascinating capabilities of the SMART Sympodium DT770 and its accompanying Notebook software is the ability select and control the colour of text (figure) and background (ground). See Figures 8, 16, 26, 27, 28, 34, 35, 36, 37, 38, 39, 40, 41, 44, 45, 47, 48, 49, 50 and 55. Providing the student with a palette of colours and allowing him to make the choice as to his preferred background colour and text colour is something that was not possible prior to the advent of this technology. I have observed that this capability has a significant impact on students. Once a student sees this facet of the software, they are somewhat amazed and appear to experience a sense of awe and relief at the same time. Helen Irlen (2002) has done considerable research into the area of colour-based technology as an aid to developing literacy.

The use of focusing-type tools included within Notebook software, e.g. screen shade and spotlight can focus attention on any text feature, e.g., the onset or rhyme (Figure 11. or 12.). The spotlight can focus a student's attention on punctuation (Figure 32.). The use of the animation tools can provide educators with the ability to create a tachistoscope (Figure 31.). A tachistoscope is a device that displays an image for a specific amount of time. Activities using this resource allow visual information to fade in and out to help develop visual memory and visual sequential memory skills. It can also be used to increase recognition speed. A moving cursor is a standard feature on the screen that we have almost taken for granted; however it can be a very helpful aid in an instructional screen environment. Surprisingly the cursor, I-beam or arrow on the screen, can help the teacher point to a particular part of the screen or lesson. The cursor is omnipresent and the teacher can manipulate it to help the child to track print as it hovers above the intended instructional area of a document. Additionally by using the I-beam the teacher can help the student with the directionality and sequence of print (Clay, 2005a) in screen environments.

Multimedia Resources

During the investigation, a multimedia alphabet book was created to support alphabet knowledge and phonemic recognition. The teacher and B.B. were able to create an alphabet book with an auditory dimension (Figure 7. and 8.).

B.B. was able to take this virtual alphabet book home to view it, read it and listen to it, at his leisure, on his computer's sound system. This helped B.B. to develop mastery of the graphemic and phonemic nature of the alphabet. B.B. also remarked at the large size of the font and how this supported his learning. As B.B. could control the screen he derived great

pleasure from pressing the audio button continually and hearing the correct phonemic model articulated. As B.B. was not pronouncing the /t/ sound of the letter /T/ in a clear manner, the audio capabilities of the technology helped him to be sensitive with respect to the reception and production of this sound.

B.B. was quite impressed with the animated dice and he mentioned that the animated dice were a factor in helping him learn to read. This was quite a compelling activity that motivated B.B. at a time when he needed a boost to help him achieve additional phonemic blending skills and get to the next level resulting in a 'change in processing'. (Figures 21. to 25.).

Reading Recovery Inspired Methods

In the TPCK model, Reading Recovery inspired methods can be adapted to touch screen technology. The use of a multimedia alphabet book, 'breaking words', and building 'analogies' are adaptable to this technology. The ability to focus on words enables the student to build processing skills at the page, word and letter levels (Clay 2005a). Teachers, in a shared writing activity, have used the interactive technologies in 'Roaming Around the Known' (Clay, 2002) to develop books with their students using SMART Notebook software and the SMART Gallery resources. The wide range of images in the gallery and in the Essentials for Educators module are very helpful in annotating lessons and building letter and word concepts on the screen (Figures 7. and 8.).

The interactive nature of the screen was also effective in helping B.B to problem solve unknown words, i.e., using something that he knows, to get to something that he does not know (Kaye, 2008). For example he could get to the unknown word 'smell' from his previous knowledge of 'sm' and 'ell' (See figure 13. and 14.).

The Portability of Technology – Home and School and Beyond

Reading Recovery inspired methods also rely on a connection with the home since success is based on a 'partnership' between the home and the school. An important element of Reading Recovery method is the sending home of texts and 'cut up words.' In a similar manner, technology can be used to send home texts and files in digital format.

B.B. transferred files to and from home on a USB key. He was able to open up Notebook files as he downloaded Notebook, Version 9.7 on his home computer. [His teacher sent his family specific instructions as to how to download the software from the Internet onto their computer.] B.B.'s parents were very keen to support this practice. There was a sense of recognition that the school was adopting contemporary tools to teach the basics. This built confidence in the school and transmitted the message that the school was keen to use familiar and modern 'tools' to help B.B. learn to read. This brings to light a socio-cultural connection as the USB key is a 'sign' that that transmits additional meaning as a contemporary teaching and learning tool.

As B.B. had SMART Board in his classroom, Notebook files could be sent to his classroom where they could be opened up on the classroom computer to further reinforce his learning. As an extension of this, a teacher could send files as attachments or load them on a website for convenient asynchronous access. This capability can prevent the loss of work when it is transferred from one location to another. Within the context of interactive screen technologies,

the pen input capabilities could be used to annotate and highlight key elements of a lesson, e.g., Figure 32. and 33. This can involve parents in the teaching and learning as they can 'review' the processes that teacher and student use to build the concept(s), i.e., they can observe the, pen annotated, instructional actions that take place during the teaching of the lesson.

There has been significant growth in the field of distance, online education. This is an educational activity and process that is mediated by computer technology. What impact will this phenomenon have with respect to our notion of the in-person relationship as opposed to a vicarious one? How does the impact of our teaching practice differ during the in-person relationship vis-à-vis the virtual relationship? I have personally instructed hundreds of educators, in online distance education courses, never having been involved in an in-person, 'in flesh and blood', instructional relationship with any of them.

Teacher Efficacy and Student Agency

I feel very fortunate to have had the opportunity to conduct this study. It has afforded me the opportunity to observe a variety of communities in interaction. Between the home and school there was a great deal of support that was critical to student success. Bandura posits "Teacher sense of efficacy, in part, influences the degree of parental participation in their child's educational career (1997, p. 246). Teacher with high self-efficacy and schools with high collective teacher efficacy provide support to parents and seek them out as partners (Bandura as cited in Tschannen-Moran and Barr, 2004). This reinforces a critical feature of the Reading Recovery approach, as Reading Recovery places a very high value on the involvement of the parental subcommunity.

As mentioned B.B. could input his name within the electronic books, that were purchased, on a compact disk (CD), to promote paper and screen literacies. It was extremely encouraging and motivating for B.B. to see his own name represented in screen-based and paper-based texts (Figure 33.). B.B. realized the agency in being able to personalize and customize his lesson content and activities. This the not unlike the description by Tapscott, of the Net Generation in the book *Grown Up Digital*, "the Net Geners get something, and want to customize it….they make it fit their personal needs and desires (2009, P. 78). Zorafass (2005) states that, "Electronic text affords alternative formats for reading materials that can be customized to match learner needs, can be structured in ways that scaffold the learning process and expand both physical and cognitive access, and can foster new modes of expression through revision and multimedia" (Zorafass cited in NCREL, 2005). Once again these digital resources enable teachers to differentiate instruction.

Using these digital texts, B.B. began to enjoy printing out digital books in print form for himself and his classmates. On occasion he would print out multiple copies of the book, then take them back to class and form a reading group of three students. These students, to their surprise, found their names included in the text of the story. How engaging was this for B.B. and his peers!?

On one occasion there was a visiting Grade 3 teacher who observed B.B. using the Sympodium DT 770. She observed B.B. reading electronic text on the screen. This Grade 3

teacher mentioned that one of her students would benefit from a similar text of this nature. B.B. and I offered to create some personalized printed texts for her. We asked for the name [pseudonym used] of the student in question. At this point B.B. became an agent of instruction. The ability to input his name into the text, allowed B.B. to perceive himself as a producer of technology instead of a consumer. He was extending his role as an emerging reader into a publisher who had an audience. He was now taking book orders from a teacher in another school. This was an improbable agency for a non-reader in Grade 2. He sent his second book to the other school in December and his third for Valentines' Day.

How empowering can digital technologies be for our students? They may be very empowering as students learn what it means to be successfully and meaningfully engaged as they learn to negotiate and create the texts of the Information Age (Lotherington, 2005). She elaborates,

> Our explorations into the emerging multiliteracies of the 21st century will help to inform us on how to educate children to function in and to co-create the social worlds they will eventually enter as literate adults. Our project merges modern literacies (i.e. Industrial Revolution inspired paper-based, print centred texts) with postmodern literacies. (Information era inspired screen-based, image-centred texts) and looks at how children negotiate these worlds of encoded information. The multiple literacies children are developing as a matter of 21st century socialization portend much-needed educational reform. (Lotherington, 2005).

The agency to locate oneself or one's own name in a reading text may potentially result in the ability to read higher level texts, e.g. on a number of occasions, I would try to introduce both print-centred text and screen-centred electronic text within the same lesson. It appeared that B.B. was able to read a higher level text on a screen than in a printed text, e.g., reading Level 7 in a digital form and a Level 4 in traditional print form! How much this had to do with B.B. being able to input his name into the story is uncertain.

One day B.B. came up to me and he was wagging his USB Key, to and fro, in front of me. As I pondered his actions he informed me, "I have my USB Key! I have my USB Key!"
Much to my amazement, B.B. was actually asking for some additional files to take home on his USB Key. In effect he was asking for more homework. The last time a student came up to me, wagging his homework book and asking for more homework, escapes me. Could the electronic files that were being sent home to B.B. be so compelling that he wanted more?

Pen Annotation Technologies – Sympodium DT 770 and Notebook Software

One of the pleasant surprises of this investigation was the ability to use a pen to annotate information on the screen (Fig. 32, 33, 37, 38, 39, 41, 45, 46, 47, 50 and 51). The Sympodium DT 770 is equipped with a special pen that is tethered to the monitor. The ease with which one can use this device is encouraging. One needs simply to lift the pen, select a style, and then begin to write or encode information on the digital document. Wolfe (2002) found that,

> Although most keyboard and mouse interfaces for online annotation are cumbersome—requiring the user to select a command, point with a mouse, and type on the keyboard—hand-held reading appliances allowing pen-based freehand input can imitate the ease

> and functionality of working with paper… is one example of an annotation system that seems to incorporate the functionality of the computer with the ease and flexibility of paper (p. 478).

This pen technology provides us with the ability to highlight, underline, separate and circle the document on the screen. This can take the form of strokes or symbols that are drawn to address some specific text feature. In Figure 44., D.D. was able to annotate and highlight the presence of quotation marks. A green circle was used to locate the quotation marks and the symbols '1' and '2' were used to indicate opening and closing quotation marks respectively. In Figure 51, D.D. was able to search for some letter patterns by highlighting vowel digraphs.

> The ability to annotate appears to be a powerful tool in focusing attention and highlighting important features of text. Besides supporting concentrated, intensive reading, annotation tools can also support skimming strategies by highlighting keywords in a document that would allow the reader to quickly locate passages of interest. (Wolfe 2002, p. 479)

Over the past twenty years I have had the opportunity to work with a number of draw programs, from those developed for classroom use, to those developed for professional use. I have found that the draw environment within SMART Notebook software to be an extremely 'friendly' environment. The ability to move, scale, lock, group, duplicate and hyperlink objects makes for a relaxed learning curve. Of particular importance is the ability to select a text object, locate a 'handle' on one corner and resize the text box to a desired magnitude. One simply watches, in amazement, as the text size is increased or reduced with no apparent change in resolution or clarity. Although very powerful, this is a particularly natural and seamless process. Resources and capabilities such as these reflect a draw environment that is intuitive and easy to learn.

Questions for Further Study

In the middle of November B.B. moved quite spontaneously from working on my left side which was associated with the print-centred materials to my right side in front of the Sympodium screen, the side associated with screen-centred learning (Figure 5). In January after B.B.'s reading processing system became somewhat more 'self extending' (Clay 2005a) and robust, he spontaneously moved back to the left, the printed-centred area (Figure 4).

Through the use of digital technology, I was able to send the activities that we were working on in a FITS scenario to B.B.'s teacher. What is the potential of this capability? Worksheets are not lost in the movement from one classroom to another. Do the communication resources of digital technologies allow teachers to work more collaboratively and seamlessly by transmitting lessons to and from their workstations? How could this help teachers? How could this help students? How could this help parents, guardians and family members? What are the benefits of being able to view the way that learning is scaffolded, annotated and recorded in a focused individualized touch screen environment [FITS]?

At times, it appeared that B.B. was able to read a higher level screen text as opposed to a printed text, e.g., reading Level 7 in digital form and Level 4 in traditional print form! How might we account for this discrepancy? I might hypothesize that B.B.'s ability to see his own name

represented on the screen and in electronic texts provided additional motivation in learning to read and navigate the information on the page. Perhaps this would explain B.B.'s thoughts when interviewed about his personalized books, "In the dinosaur book, seeing B.B. (states his own name) makes me like to read it." My name is in there. It is like I am famous! Like a Famous Artist!" The agency to locate oneself or one's own name in a reading text provides some additional ownership of the text. This sense of ownership may create the conditions for the child to be fully invested, in an emotional sense, with the text. The impact of this emotional investment and attachment may provide enough impetus to overcome the barriers of a more demanding text. It might be interesting to compare student reading level preferences and capabilities in traditional print form as opposed to reading level preferences and capabilities in screen environments. This may be significant as the screen becomes more and more a site of representation (Kress, 2003).

Interactive touch screen technology, in the form of an IWB, is very much in demand by teachers wishing to incorporate technology into their teaching practice. The development of this technology and its accompanying software has the potential to transform teaching and learning. The IWB is a multifunctional tool that provides an enhanced instructional capability for sharing digital information and it creates a compelling medium that engages students. There are economic challenges that may restrict the widespread use of this tool, however, many teachers and their administrators are finding creative ways to locate resources for interactive whiteboard technology [IWB]. In light of the changing nature of our 'Net Generation' learners what tools and resources will be available to help teachers introduce and develop 21st century skills?

This investigation has focused on three major themes: how interactive touch screen technology can enable both a teacher and student, as they sit side by side, to engage in an assisted, shared, literacy activity; how the components of technology, pedagogy, and subject content come together to create a collaborative knowledge that lets us examine the role of technology in teaching and learning; and, how the passing on of knowledge and skill generally involves a teacher and student but can be mediated by some other artifact or in Bruner's words, 'a responsive computer'. Each of the aforementioned themes presents a complex set of relationships: instructional actions, curriculum design and social cultural theory. It appears that the computer and digital media are becoming an integral, if not significant part of each; more and more of our human exchanges and social interactions are being mediated by the computer and digital technologies.

I would like to thank all the students, without whose efforts none of this work would have been possible. I would also like to thank all the parents, teachers, and professors who supported me in this project.

References

Bell, M. A. (1998). *Teachers' perceptions regarding the use of the interactive electronic whiteboard in instruction.* Retrieved on July 23, 2008 from http://smarterkids.org/research/paper6.asp

Bolter, J. D., & Gruskin, G., (1999). *Remediation* Cambridge, Massachusetts, The MIT Press.

Bruner, J. (1996). *Culture of Education,* Massachusetts, Harvard University Press.

Clay, M. M. (2002). *An observation survey of early literacy achievement*. Portsmouth, NH: Heinemann.

Clay, M. M. (2005a). *Literacy lessons designed for individuals part one: Why? When? and How?* Portsmouth, NH: Heinemann .

Clay, M. M. (2005b). *Literacy lessons designed for individuals part two: Teaching procedures.* Portsmouth, NH: Heinemann

Goodman, Y., Watson, D., & Burke, C. L. (1987) *Reading miscue inventory; alternate procedures*. New York, NY, R.C. Owen Publishers.

Irlen, H. (1998). *The Irlen method - helping children and adults with processing problems*. Retrieved July 14, 2008 from http://irlen.com/index.php

Kaye, E. L., (2008). *Taking words a-part, ap-art, apar-t while reading.* Journal of Reading Recovery, Ohio. V8(1) 5-15.

Kress, G. (2003). *Literacy in the new media age.* London, Routledge.

Lotherington, H. (2005). *Writing Postmodern Fairly Tales at Main Street School: Digital Narratives and Evolving Transliteracies*. McGill Journal of Education; v40 n1 p109-119 Win 2005.

McLuhan, M. (1964). *Understanding media, the extensions of man*. London, Rutledge and Kegan Paul.

Ministry of Education and Training (1995). *Information Literacy and Equitable Access (ILEA)*: Draft Document, Ministry of Education and Training, Toronto, Ontario.

Mishra, P., & Koehler, M. J. (2006). *Technological pedagogical content knowledge: a framework for teacher knowledge*. Teachers College Record Volume 108 Number 6, 2006, p. 1017-1054.

New London Group. (1996). *A pedagogy of multiliteracies: designing social futures.* Harvard Educational Review, Volume 66 Number 1, Spring 1996, Retrieved on June 16, 2008 from

http://wwwstatic.kern.org/filer/blogWrite44ManilaWebsite/paul/articles/A_Pedagogy_of_Multiliteracies_Designing_Social_Futures.htm

NCREL (Mid-Continent Research for Education and Learning). *Using technology to improve student achievement.* Retrieved on July 18, 2008 from http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te800.htm

Ontario College of Teachers. (2006). *The foundations of professional practice:Tthe standards of practice*, Ontario College of Teachers. Toronto, ON: Author Retrieved on January 14, 2009 from http://www.oct.ca/publications/PDF/foundation_e.pdf

Reading Recovery Council of North America, Retrieved on July 30, 2009. http://www.readingrecovery.org/index.asp

Reinking, D., McKenna, M., Labbo, L.D., & Kieffer, R. D. (1998). *Handbook of literacy and technology: transformations in a post-typographic world.* New Jersey Lawrence Erlbaum Associates.

Rudd, T. (2007). *Interactive whiteboards in the classroom.* Futurelab, Innovation in Education. Retrieved on December 14, 2008 from http://www.futurelab.org.uk/events/listing/whiteboards/report

Sentech, Special Education Needs Technology. Sentech *Hardware: Peripherals.* Retrieved July 18, 2008 http://www.sentech.ie/hardware.htm

SMART Technologies. *Sympodium DT770 interactive pen display, dual touch.* Retrieved on May 12, 2008 from http://www2.smarttech.com/st/en-US/Products/Interactive+Pen+Displays/DT770/

SMART Technologies. *Smart notebook software, download.* Retrieved on May 12, 2008 from http://www2.smarttech.com/st/en-US/Support/Downloads/default.htm

Solvie, P.A. (2001). *The digital whiteboards as a tool in increasing student attention during early literacy instruction*. Retrieved March 23, 2004, from www.smarterkids.org/research/paper13.asp

Sutherland, R. (2004). *Designs for learning: ICT and knowledge in the classroom*. Computers and Education, Vol. 43, Issues 1-2 pp. 5-16.

Tapscott, Don, (2009). *Grown up digital*, *how the net generation is changing your world*? Toronto, McGraw Hill.

Thornburg, David. *"Any teacher that can be replaced by a computer, deserves to be."* Retrieved March 23, 2006 from http://thinkexist.com/quotes/david_thornburg/

Thornburg, David, (2002). *The danger of technolust*. Retrieved September 23, 2006 from http://www.pbs.org/teacherline/resources/thornburg/thornburg0302.cfm?cc=tlredir

Tschannen-Moran & Barr, M. (2004). *Fostering student learning: The relationship of collective teacher efficacy and student achievement*. Leadership and Policy in Schools 2004, Vol 3, No 3. pp. 189-209.

Wolfe, Joanna, (2002). *Annotation technologies*: *A software and research review*. Computers and Composition; v19 n4 p471-97 2002.

The Centre for Universal Design. *Universal design principals.* Retrieved on July 14, 2008 from http://www.design.ncsu.edu/cud/about_ud/udprinciples.htm

Vygotsky, L. S. (1978). *Mind in society: development of higher psychological processes*. Massachusetts, Harvard University Press.

Williamson, G. (2005). *What are multimodality, multisemiotics and multiliteracties? A brief guide some jargon*. Futurelab, Innovation in Education. Retrieved on December 18, 2008 from http://www.futurelab.org.uk/resources/publications-reports-articles/web-articles/Web-Article532

Children's Texts Cited

Adler, D., (2004). *Cam Jansen, the mystery of the Babe Ruth baseball.* Puffin Publishers.

Donaldson, M. (1974). *Nine True Dolphin Stories*. New York, Scholastic.

Pioneer Valley Books, (2004). *Bookbuilders series of software*. Distributed by Literacy Footprints.

Rendell, B., Giles, J., and Smith, A., (1996). *Dad.* Nelson New Zealand, Price Milburn Ltd.

Smith, A. (2001). *Stone Soup.* Nelson Education Ltd.