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## **How Students Comprehend Using E-readers and Traditional Text: Suggestions from the Classroom**

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### **Reading Comprehension of Print and Digital Text**

Since Durkin's groundbreaking research on comprehension in 1978, the quality of comprehension instruction has been a core research topic in reading comprehension research circles. However, the majority of this research over the past 30-plus years has focused primarily on comprehension of print text. We know from research that skilled readers read with purpose, preview the text, activate their background knowledge, make connections between old and new information, ask questions, use strategies to fix meaning when it fails, and self-monitor their understanding (Block & Pressley, 2002; National Reading Panel, 2000; Pressley, 2006; Rosenshine & Meister, 1994). Current research suggests that comprehension of print text are necessary when reading digital text, but not sufficient; digital text requires additional strategies (Coiro & Dobler, 2007; Leu, Kinzer, Coiro, & Cammack, 2004).

The purpose of this paper is to apply lessons learned from previous research to suggest teaching strategies that could improve students' comprehension in digital environments. The strategies were chosen based on research regarding reading in digital environments; including information about comprehension on the Internet and comprehension on the e-reader. In both environments comprehension is seen as a complex process involving multiple strategies.

Current research is redefining reading comprehension in a digital environment and the comprehension strategies for online reading comprehension are emerging (Leu, Coiro, Castek, Hartman, Henry, & Reinking, 2008; Coiro, 2009; Hartman, Morsink, & Zheng, 2010). A common theme of all the research is that reading in an on-line environment is multifaceted and requires knowledge of search engines, authorship, and organizational features within websites (Coiro, 2005). Research on user studies has shown that students who lack knowledge of digital comprehension usually have a difficult time staying focused; thus, causing ineffective tangents and increased frustration levels that result in frequent breakdowns when reading in the digital environment (Brandt, 2000).

E-readers are digital devices that create a new reading environment for the student. They present traditionally static text in a digital format adding features such as embedded dictionaries and electronic searching. By simply clicking on a word the reader can choose to look it up on the built in dictionary or on the Internet. The additional features of e-readers can affect students' comprehension (Wilson, Zygouris-Coe, & Cardullo, submitted for publication, 2012)

A strategic component of comprehending print text is the development of awareness of purpose, a concept that although applicable to print text, can be "problematic and convoluted" in an online environment (Sutherland-Smith, 2002, p. 663). The multi-directionality of the online reading environment can potentially lead immature digital readers astray to follow recursive links and become diverted from their original reading purpose. It is because of situations like this that some researchers advise that students require additional comprehension skills to maneuver through digital text effectively; we need to enable them to read and learn more effectively in a digital environment (Coiro, 2005). A prerequisite for comprehension of complex text, print or digital, is metacognition.

### **Metacognition**

Metacognition is the process by which students critically reflect on and monitor understanding. It refers to readers' thoughts and the awareness of their thoughts as they engage in the reading process and monitor their understanding of text (Flavell, 1970). Proficient readers engage with text by actively thinking about what they are reading, ask and generate questions, make and confirm predictions, reread as needed, problem-solve, and reflect on what they are reading, thereby activating their metacognitive skills (Kamil, Mosenthal, Pearson, & Barr, 2000; National Reading Panel, 2000; Snow, Burns, & Griffin, 1998).

Over the past several years, metacognition has played an important role in teaching students to comprehend text. Lawless and Schrader (2008) explored the work of numerous researchers that demonstrate a strong connection between metacognition and navigation in a digital environment; they viewed navigation as an active constructive process, which includes

virtual movement through cognitive space made up of data and knowledge. In a recent study, Schwartz, Anderson, Hong, Howard, and McGee (2004) found a strong positive and significant correlation between metacognitive ability and successful navigational outcomes (as cited in Lawless & Schrader, 2008) further supporting the idea that students experienced with navigation exerted fewer cognitive resources, thereby allowing the reader to develop stronger metacognitive regulation and control of their learning environment (as cited in Sperling, Howard, Miller, & Murphy, 2002). Virtual navigation requires the user to know where he is at, where he needs to go and how he will get there; metacognition is the cognitive ability to navigate and monitor a path to information or destination.

The variety of strategies used with print text expanded when Coiro and Dobler (2007) explored students' reading of digital text. The authors found that reading Internet text led to the coordination of simultaneous application of strategies such as using prior knowledge, inferential reading and self-regulation in a complex manner not used with print text. Furthermore, Leu et al., (2008) found that digital reading is not congruent with print comprehension and experienced readers are not always competent online readers therefore reading strategies may not transfer cognitively. Thus, the need to be a flexible reader is even more important as students read digital text. As students navigate information in a digital environment they will rely upon these same thinking processes to comprehend, synthesize, and evaluate information from multiple texts. Since digital text is fluid and requires high levels of critical thinking (e.g., accessing information in multiple places, visiting and revisiting various resources, and critically analyzing their next "reading move"), teaching strategies for comprehending digital text should be a core instructional goal.

Although many of the same metacognitive strategies are used with both print and digital text, the strategies differ in their usage (Hartman, Morsink, & Zheng, 2010). For instance, in both settings students need to determine a purpose for reading. In the print environment the purpose determines why the reading is being done. In the digital environment the reader's purpose helps to negotiate a path for retrieving information. This strategy guides the student into a more complex process of understanding and evaluating digital material. The process differs for other strategies as well. Hartman et al., (2010), also pointed out that digital text is multifaceted and requires more complex strategies. The nature of the text means that it cannot be mapped out ahead of time since students do not move from point A to point B in a linear path, rather they are interacting within a recursive environment.

When reading digital text, readers move quickly in and out of multiple levels of critical thinking as they challenge authorship, validity, and accuracy of information while identifying the location and direction of a link or site (Hartman et al., 2010). Students move through this process as goal-oriented learners, metacognitively thinking about the outcome and process while at the same time focusing on the purpose. It is critical for teachers to model the development of metacognitive self-monitoring strategies if students are to become successful, mature, and masterful readers.

Classroom teachers guide students in learning how to comprehend text by making thinking visible; "calls for the externalizing processes of thought so that learners can get a better handle on them" (Ritchhart, Church, & Morrison, 2011, xiv). It requires that teachers share their

problem-solving with students while supporting the development of students' critical thinking skills (Marzano & Kendall, 2008). This is accomplished by making the process of metacognition visible to students by modeling or thinking aloud.

### **Think-Alouds and Comprehension of Digital Text**

Think-alouds provide teachers with an abundance of opportunities to explicitly model their own thinking for their students while demonstrating comprehension strategies and self-monitoring processes. For reading comprehension, thinking aloud is a strategy used to verbalize what one is thinking as one activates comprehension strategies. Summarizing, predicting, and questioning strategies can be modeled through the think-aloud process by reading coaches, classroom teachers, learning strategy specialists, and speech-language pathologists across grade levels to help students read and comprehend digital text through the think-aloud process. Used for transference of reading comprehension strategies from print text to digital text, teacher modeling through think-alouds provides students with eyewitness experiences to both see and hear the transference of reading strategies from print to digital text. Through teacher support students can begin to adapt well-known effective print reading comprehension strategies for use in the digital arena.

Many strategies (e.g., activation of prior knowledge, inferring, summarizing, or predicting) can be transferred with little or no modification to digital text. Hall, Bowman, and Myers (2000) suggest the above strategies (e.g., activation of prior knowledge, inferring, summarizing, or predicting) are comprehension strategies used by mature readers in print environments. If modifications of these strategies are needed, teachers should use the think-aloud process to model the necessary modifications.

After successful modeling of the thinking process in print text, the next step would be to model the same strategies in a digital environment. For example, if modeling the strategy of evaluating the quality of the text in a digital environment, an additional step of validation of authorship would be demonstrated. Above all teachers need to convey clearly the idea that anyone can publish on the Internet but a mature reader seeks validation of authorship.

### **Text Coding and Comprehension of Digital Text**

Text coding is a specific comprehension monitoring strategy that teachers can model in both print and digital text. Text coding helps students keep track of their thinking while they are reading. The students mark the text as they read using a code or note to record what they were thinking during the process. The coding system is simple including symbols or abbreviations for key metacognitive strategies such as connections, self-questioning, and self-regulation of meaning making. The recording of codes helps the students identify strategies and know when they need to go back to areas in the text. The codes are illustrative of students' self-monitoring during reading.

In the print environment students engage in text coding using sticky notes or by writing in the text. The strategy of text coding could help students transfer strategies to the digital environment as it calls attention to the strategy and highlights the steps that students may need to

take during the reading process. Teachers model the use of sticky notes, highlighting, and/or paraphrasing and summarizing of print text using highlighters, sticky notes, or interactive paper-based notebooks. In the digital environment students use the tools in programs such as Portable Document File readers and word processing programs to code to the text. They use electronic features such as digital highlighting tools, sticky notes, and in-text note features. Figure 1 offers a variety of methods for text coding digital text as well as the possible thought processes (i.e., think-alouds) that could underlie certain text-codes.

Figure 1

*Comparison of Reading Strategies Used with Print and Digital Text*

**Print Text**

**Awareness of Purpose**

“I need to find a quote or a fact that will support my ideas about what should be done about acid rain.”

**Discovering New Meaning of Words**

“I don’t know what that word means. It seems like it is important because it is used several times in the next few sentences. Let me reread that to see if it makes more sense. Was it explained earlier and I missed it or is the definition coming up? If I can’t figure this out, I am going to need to get a dictionary, check the back of this book, or ask someone else for help.”

**Interpreting the Text and Conversing with the Author**

“I wonder if there is something in this author’s background or experiences that has made him write the text this way? I guess I will have to ask the teacher or try to find a biography or another book or article that talks about the author and why he writes this way.”

**Digital Text**

**Awareness of Purpose**

“I need to be careful not to get distracted by anything that is flashing, or by chasing links, or even checking my e-mail, because I don’t have too much time today. I need to log on to the Web and do a Google search to find information about acid rain. Maybe there will be a chart or graph or something else that will help too. If I can’t find that with Google, I might need to use a different search engine that will let me search specifically for multimedia besides just text.”

**Discovering New Meaning of Words**

“I am not really sure what that word means. Let me click on it--it’s blue so I think there is a link to something else. Hopefully, it will tell me what it means or send me somewhere else where the word is explained better that it is here. I just don’t want to go away from this page too far and forget where I am!”

**Interpreting the Text and Conversing with the Author**

“I wonder why the author said that. Maybe there will be an email address somewhere on this page where I can write and ask him. Or maybe there is a bulletin board where I can look to see if anyone else has ever had this same question before...”

*Figure 1.* Comparison of Reading Strategies Used with Print and Digital Text. Adopted from “Teaching Online Comprehension Strategies Using Think-Alouds.” A. Kymes. 2005. *Journal of Adolescent & Adult Literacy*, 48(6), p. 487. Copyright 2005 by the International Reading Association.

**The Gradual Release of Responsibility Model**

The process whereby teachers help students develop expertise in a concept and then systematically turn over control for learning to them is known as the Gradual Release of Responsibility (GRR) model (Farstrup & Samuels, 2001; Pearson & Gallagher, 1983). According to the GRR model, the teacher pre-assesses student knowledge of topic or task at hand, provides explicit instruction with modeling, allows for guided practice and provides feedback, directs students to independent practice, and finally, assesses student application of skills, knowledge, or strategies.

**Gradual release of responsibility and think-alouds.** Embedded within the think-aloud process, the Gradual Release of Responsibility (GRR) model provides a useful model teachers can use to support students' comprehension of digital text. This approach requires that the teacher transitions from assuming "all responsibility for performing a task... to a situation in which the student assumes all of the responsibility" (Farstrup & Samuels, 2001, p. 211). The model progresses through multiple, purposeful stages that strategically shift the cognitive load from the teacher as a model to joint responsibility between the teacher and the learner to independent practice and application by the learner (Pearson & Gallagher, 1983). In essence, the student first watches the teacher perform the strategy, then the teacher and student do it together, and finally the student engages in tasks utilizing the strategy as the teacher looks on and provides coaching and counsel as needed.

Support for using the GRR model with think-alouds comes from Pressley (2000) and Wihlelm (2001) who both studied the effectiveness of think-alouds when developing reader comprehension of print text. Gradually turning over responsibility for the components explored in the think-aloud demonstrates to students what thinking strategies look and sound like while engaged in the reading process. Thus, this method should allow students to begin the process of metacognition through modeling and explicit instruction (Kymes, 2005) and assist students' thinking by modeling comprehension strategies through a think-aloud process using both print and digital text examples. Ideally after much practice and scaffold teacher support, students will be able to practice using the strategies independently, leading gradually to thinking aloud on their own (Duffy, 1993).

**Gradual release of responsibility and text coding.** The GRR model works well when teaching students text coding strategies with digital text. The process would start with a teacher using a digital text, then pausing and posing specific questions related to the text and text coding. The effective use of text coding can be utilized in print text using symbols. For example, when a student has a question when reading they would mark the section with the symbol "?" next to the sentence. This symbol signals that they had a question about something they just read. The highlighting as noted in Figure 2 demonstrates how text coding is applied and modeled with digital text. The colors are selected from the MS Word Text Highlighting Tool.

Figure 2  
*Examples of Text Codes for Digital Text*

Reader's Thought	Text Codes for Print Text	Text Codes for Digital Text
I have a question about this.	?	I have a question about this. Yellow Highlighting
I agree with this.	=	I agree with this. Blue Highlighting
I disagree with this.	X	I disagree with this. Turquoise Highlighting
This is interesting!	!	This is interesting! Pink Highlighting
This is confusing.	~	This is confusing. Bright Green Highlighting
This is important.	*	This is important. Red Highlighting
This reminds me of...	@	This reminds me of... Teal Highlighting
Important Date	#	Important Date Dark Yellow Highlighting
I wonder....		I wonder.... Gray Highlighting
I have a prediction.	P	I have a prediction. Dark Red Highlighting
I can picture this.		I can picture this. Dark Blue Highlighting
Word I don't know		Word I don't know. Underline

An example of how this strategy is applied is illustrated in Figure 3 in an excerpt from "Hole in My Life" by Jack Gantos (2002); column one shows traditional text coding and column two shows the transference to highlighting digital text.

Figure 3  
*Examples of Print and Digital Text Using Text-Coding*

**Print-Based**  
 At the time this picture was taken, I weighed 125 pounds. When I look at my face in the photo, I see nothing but the pocked mask I was hiding behind. I parted my □ hair down the middle and grew a mustache in order to look older and tougher, and with the greasy prison diet (Text coded with □ ) (salted chicken gizzards in a larded gravy, chicken wings with oily cheese sauce, deep-fried chicken necks), and the stress, and the troubled dreams of capture and release, there was no controlling the acne. I was overmatched.

I might have been slight– but I was smart and cagey. I managed to avoid a lot of trouble because I knew how to blend in @ (Text Coded with @) and generally sift through the days unnoticed by men who spent the majority of their time looking to inflict pain on others. I called ~ these men “skulls” and they were freaks for violence. (Text Coded with ~) Here we were, all of us living in constant, pissy misery, and instead of trying to feel more human, more free and unchained in their hearts by simply respecting one another and getting along, many of the men found? cruel (Text coded with ?) and menacing ways to make each day a walk through a tunnel of fear for others.

**Digital –Based**  
 At the time this picture was taken, I weighed 125 pounds. When I look at my face in the photo, I see nothing but the pocked mask I was hiding behind. I parted my hair down the middle and grew a mustache in order to look older and tougher, and with the greasy prison diet (Blue Highlighting) (salted chicken gizzards in a larded gravy, chicken wings with oily cheese sauce, deep-fried chicken necks), and the stress, and the troubled dreams of capture and release, there was no controlling the acne. I was overmatched.

I might have been slight– but I was smart and cagey. I managed to avoid a lot of trouble because I knew how to blend in (Teal Highlighting) and generally sift through the days unnoticed by men who spent the majority of their time looking to inflict pain on others. I called these men “skulls” and they were freaks for violence. (Bright Green Highlighting) Here we were, all of us living in constant, pissy misery, and instead of trying to feel more human, more free and unchained in their hearts by simply respecting one another and getting along, many of the men found cruel and menacing ways to make each day a walk through a tunnel of fear for others. (Yellow Highlighting)

Students can also use sticky notes in a digital environment to text code. Figure 4 shows a screen snapshot of a teacher modeling the use of sticky notes and the possibilities for direct transference of skills with adapted critical thinking.



Figure 4  
Example of Digital Text-Coding on a Digital Device

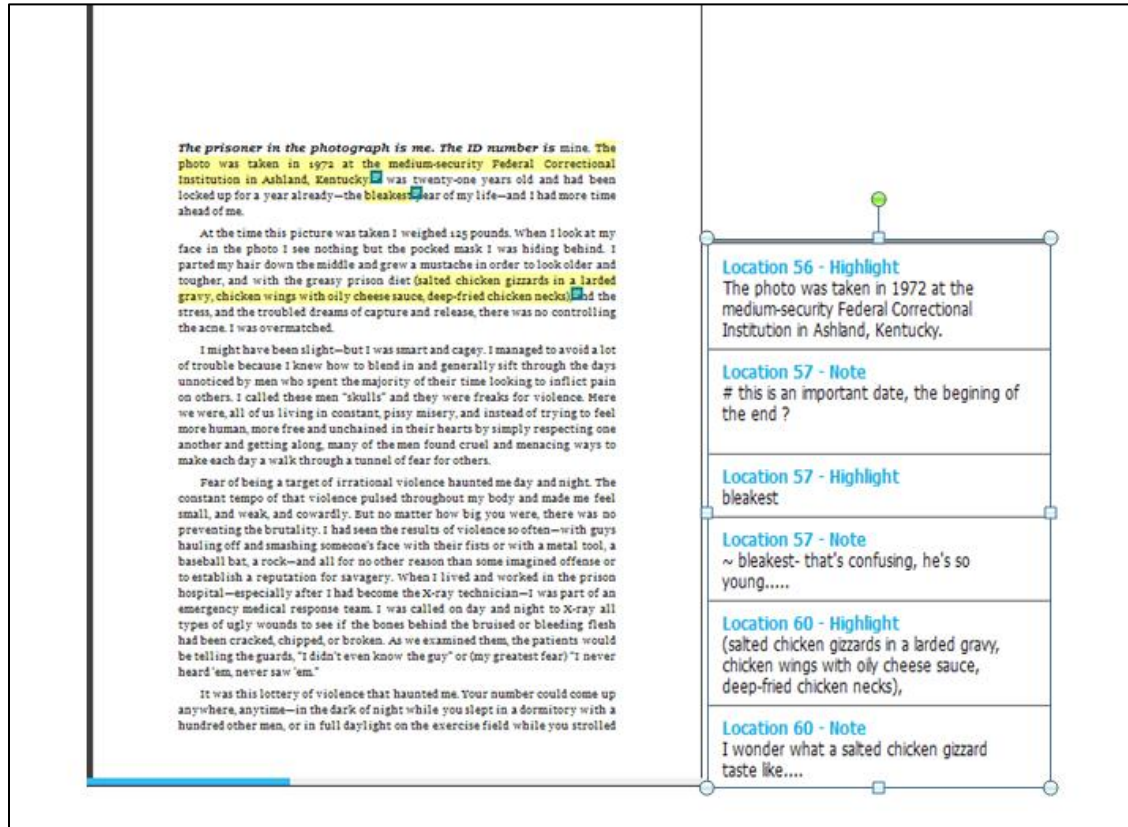


Figure 4. Example of Digital Text-Coding on a Digital Device. Text coding using sticky notes. Excerpt from *Hole in My Life*, Jack Gantos, copyright 2002 by Jack Gantos.

Just as with think-alouds, text coding can also be used as a means of interacting with text while reading in digital environments; text coding can also promote monitoring of students' meaning making from text.

### Performance Feedback and Self-Monitoring

Several studies have analyzed the inclusion of performance feedback that is frequent, robust (Alber-Morgan, Ramp, Anderson, & Martin, 2007; Allen & Hancock, 2008), complex, elaborative, and tailored to the needs of the student (Gordijn & Nijhof, 2002; Meyer, Wijekumar, Middlemiss, Higley, Lei, Meier, & Spielvogel, 2010). When students are given little or no feedback, few adjustments are made to the development of comprehension strategies. Thus, students fail to redirect their learning and consider other perspectives, or opportunities to enhance their learning. Teachers can model self-assessment and reflection as they preview resources available in a digital environment. Modeling these strategies should streamline the feedback process and make the journey from metacognitive awareness to feedback to

comprehension much smoother.

Currently there are a variety of tools available for feedback in a digital environment: dictionaries, blogs, social network tools, wikis, webinars, etc. In a print environment, readers might solicit feedback about a passage by comparing and contrasting the opinions and comments of peers and teachers with their own. However, in an online environment, a reader can create a blog, post his or her opinions or comments to a discussion board, email an author, participate in a live chat, create a wiki, or attend a webinar on a topic of interest related to assigned readings.

Performance feedback will allow the reader to self-assess and ideally attribute success or failure to their level of effort, choice of strategy, and/or complexity of pre-reading goals (Zimmerman, 1986, 1990, 2002). Self-monitoring and self-assessment can be used by the student to formulate a strategic plan for comprehension. Students can see this process developed through teacher modeling of strategy thinking. As Cleary and Zimmerman (2004) state, students are responsible for their level of effort or the strategies they select for tackling a reading task. Eventually students will begin to identify areas of strengths and needs in regards to their level of comprehension.

Metacognitive self-monitoring that spurs students to actively seek feedback and engage in meaningful self-assessment has the potential to assist readers in designing goals for approaching both print and digital text. This process will begin to guide readers' development of comprehension based on feedback and self-assessment through the metacognitive process and internal thinking strategies. Students will begin to determine whether their reading process was productive or flawed in some way as a result of inadequate effort, ill-conceived strategies, or inappropriate goals (Thiede, Anderson, & Therriault, 2003).

Mature readers whose end-goal is comprehension actively engage with text by formulating questions, making predictions, developing connections to schema, and visualizing what they are reading to further develop thoughts, ideas, and opinions. Readers develop this process to secure performance feedback (i.e., teacher, peer, self) and to initiate meaningful self-regulation of their own reading process.

### **Summary**

In this article, we proposed that digital text places additional reading, cognitive, and technological demands on the reader that far exceed decoding, word recognition, reading fluency, and basic comprehension. Online reading encumbers the reader with more processing demands.

We suggest that teachers can assist students in constructing meaning from digital text through think-aloud modeling and text coding, providing scaffolded feedback, and encouraging students to self-regulate their understanding. Coiro (2009) cautions teachers about the unique and complex nature of online reading comprehension; she calls educators' attention to the different processing knowledge and skills students need to develop to handle the interpage, intersite, and intertextual comprehension of online reading material.

Students need to develop the multiliteracies of the 21<sup>st</sup> century but they cannot do it alone; teachers must cognitively design metacognitive strategies as an essential part of teaching digital comprehension skills (Kramarski & Feldman, 2000). Students will benefit from knowledgeable and metacognitive teachers who will help them to determine their purpose, critically evaluate and synthesize online information, guide them through the metacognitive thinking process, provide deliberate and effective feedback, and teach them how to self-regulate their understanding (Kamil et al., 2000).

Our research has informed us that reading strategies that work in print environment can be transferred to reading text in digital environments but are not sufficient for meeting the demands of digital text and online reading comprehension. Leu and Kinzer (2000) suggest that because digital literacy is current, evolving, and fluid, there will be a higher demand for critical thinking skills as technologies advance and transform literacy and learning.

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