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Children's Literacy Perceptions as They Authored with Hypermedia

[Sandra K. Goetze, Ph.D.](#)

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Abstract

This study explored children's literacy perceptions as they authored with hypermedia within the context of classroom literacy lessons. The fifth grade children authored two hypermedia projects and linked these projects to novels that they read in their classroom. The learners used two different multimedia authoring tools. The children based the hypermedia projects on critical literacy themes suggested during classroom discussion.

The data yielded six broad themes along with new definitions of literacy that included technology. The children made a distinction between two types of literacy with regard to writing. Their definitions of literacy reflected both linear and non-linear types of reading. Writing conventions utilized by the children included traditional conventions and non-linear writing conventions that utilized symbols and signs. Notions of readability were redefined to reflect new definitions of literacy and included hypermedia design and sign systems as a way to add meaning for the anticipated reader.

Technological Changes In Education

Technological changes since 1980 have moved fast and fiercely. This change has had a large impact on the modes of reading and writing. The ways we read and write now are augmented to include such means as E-mail and the World Wide Web. Learners are able to send and get quick responses to E-mail. On the World Wide Web, learners encounter conflicting interpretations of text and must

be able to generate good key terms when searching for information so that they can sort through these interpretations. These changes are beginning to impact literacy instruction as more schools come into the on-line environment and seize it as a way to promote literacy understanding throughout the curriculum.

The Uses of Hypermedia

One particular technological change is the use of hypertext for authoring. According to Reinking (1997), the use of hypertext can be seen as an extended metaphor to guide reading, writing, and thinking. It is only in the hypertext environment that readers and writers can digress, jump around, and link to others' writing. The literacy experience can become collaborative and intertextual. The social element of learning, involving intertextuality and collaboration, is also expanded with technology as learners read and write in real-time with those halfway around the world and have their learning scaffolded by many capable others. This dialogic use of text functions as a vehicle to generate meaning with each new reader and writer who comes into contact with it (Wertsch, 1991). Salomon, Globerson and Guterman (1989) refer to this type of learning as computer mediated communication (CMC). According to these researchers, this term suggests that a computer provides a zone of proximal development for reading and writing that leaves the learner with socially constructed knowledge that is carried off into other forms of reading and writing away from the computer.

Technology's Impact on Schools and Literacy Learning

This notion of literacy learning is very different from the type of literacy learning that traditionally has been supported in our schools. The question of how this type of interaction with print fits with literacy instruction in schools as a new tool becomes salient. With the use of CMC and computer software packages to support literacy learning, traditional models of literacy thought and instruction must be recast. Hypertext allows learners to construct multiple interpretations of a text (Bereiter & Scardamalia, 1989). Learners can reflect on their actions and try on new perspectives. Thus, literacy practice becomes broader and more authentic (Pea, 1993).

Purposes and Research Questions

The purpose of this research was to understand children's literacy perceptions as they authored with hypermedia. It is important to investigate children's perceptions since they reflect their understanding of new learning. Two main questions from this purpose guided the study: What were children's literacy perceptions as they authored with hypermedia? And what were children's literacy perceptions of their writing growth as they authored with hypermedia? When technology is introduced as a factor to be incorporated into these perceptions, different ways of thinking may be introduced (Leu, 1996). A

pertinent example of this might be book reading and reading on the Internet. Book reading is a linear process. One can read paragraphs and pages forward or backward, but essentially reading can only move in one way. Web reading, or reading on the Internet with hypertext-markup language (HTML) based documents, is a nonlinear reading process. It has also been described as a multi-linear reading process (Reinking, 1998). One can read backwards, forwards, jump to term definitions inside the document, read excerpts that go with video or audio clips, and jump to other documents embedded in the original document. This way of reading and writing can be related to notions of intertextuality (Reinking, 1997).

Linear and Nonlinear Text as a Meaning Making Process

Nonlinear reading allows the reader to acquire intertextual excerpts all in the same document, thus representing the way we think. Given this notion of nonlinear text, it is appropriate to think about how this nonlinear form of reading and writing may shape children's perceptions of their own writing development with regard to literacy and technology. Questions about literacy growth and development hinge on how the learners' perceptions are shaped by what counts as knowledge, whether they believe knowledge is discovered or created, and where this knowledge is located relative to themselves. These epistemological lenses can be used to look at literacy development and how technology may or may not play into this development. Semiotics fits into the equation of understanding literacy development because it recognizes that all meaning making is contextual and that many systems of meaning transact with one another (Berghoff, 1994). Sign systems can be used in flexible ways to learn and to communicate as one layer for gaining a deeper understanding of how literacy development is defined by epistemological perceptions of the learner.

Defining Literacy

With the push to include a computer in every classroom and Web access in those classrooms during the 21st century, those interested in literacy education are at a crossroads to gain a greater understanding of how hypertextual reading and writing has reinvented literacy and changed the way one writes, reads and sees the world (Bork, 1981). Reinventing literacy or new ways to think about literacy needs to begin by clearly exploring what is meant by literacy in the linear sense and then by exploring changes to that definition.

In thinking about new definitions of what literacy means, one could say that the processes of expressing oneself through reading, writing, and thinking in multiple discourses are precursors to a more global definition of literacy. This new definition of literacy encompasses more of the sociocultural and cognitive aspects of learning and what Bolter (1998) refers to as hypertextual literacy. Literacy can then be understood in terms of the use of hypertext environments as opposed to strictly linear text. This is driven by the idea that the nature of literacy and learning are being redefined by the digital technologies that are quickly becoming a part of the current information age.





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Broader Definitions of Literacy

Technology and computer use have played into this broadening definition of literacy because one is able to now represent text, learning, and ideas in multiple ways, such as with buttons, scrolling bars, text, graphics, and images (Reinking, 1998). Technology in a broad sense can be defined as any tool that moves one toward being more literate, such as a calculator or a computer. Throughout this study notions of technology centered on the use of computers and hypertextual environments that utilized non-linear text to convey ideas and meanings. Reinking (1998) and Bolter (1998) refer to this new term that defines a new type of literacy as hypertextual literacy. Hypertextual literacy is the marriage of hypermedia and hypertext into new ways of thinking, reading, and writing that moves learners away from alphabetic code and toward a wider range of symbolic elements. This new definition poses questions that ask: What is considered to be text? What elements comprise text? How are texts appropriately structured? These questions help to frame how our definitions of literacy are changing and will continue to evolve as our understanding of technological transformations of literacy move into a post-typographic world (Lemke, 1998; Reinking, 1998).

Looking at other new definitions of literacy and technology, hypertext or nonlinear text, provides us with new production skills not used before. The production skills are learning how to make effective choices in framing, point of view and style, learning how to use visual and auditory symbolism, and learning how to manipulate time and space through editing (Flood & Lapp, 1995). Eisner (1994) sums up the ideas best when he describes a conceptualization of literacy as one that allows for multiple forms of representation. Multiple forms of representation include visual literacy and media literacy. Visual literacy is described as art, drama, television, film, and media literacy is defined as the understanding and production of messages through physical devices (Flood & Lapp, 1994). And to broaden this definition of literacy further, Lemke (1998)

adds that we can define literacy as a set of cultural competencies for making socially recognizable meanings by the use of particular material technologies and by the use of particular material artifacts that mediate the process. All of the definitions of literacy have some common elements that are reflected in the current research (Reinking, 1998). Tierney and Damarin (1998) describe the common elements as multiple ways of knowing, semiotics, and the confluence of perspectives that can be built from cultural differences. Literacy and technology are terms that are now linked together in the question of: What is literacy? (Bruce, 1997). Ong (1982) states that the materials and processes of creating texts have linked the two ideas together in a way that one cannot be realized without the other. The definitions of what literacy is have evolved to reflect the communicative aspects of reading and writing but also the effects of technology.

Theoretical Framework

The research was grounded in sociocultural literacy learning theory. Dialogue and collaboration surrounded much of the learning in this study. Literacy and technology combined were the vehicle for learners to achieve new learning within the social collaborations. The children authored collaboratively and social interaction was a large factor in shaping how they responded. Semiotics was also important to the topic because of the way writing could be constructed in hypermedia environments, unlike how it is constructed in linear text. The roles of stance and intertextuality also supported and helped to examine the research in that stance and intertextuality notions helped to illuminate understanding for multiple ways of knowing.

Sociocultural Learning

To gain a better understanding of how learning is influenced by technology and literacy it is appropriate to explore learning in the sociocultural realm. Sociocultural learning has grown out of the work done by Vygotsky, Bruner, Piaget, Cole, and Wertsch. The roots of sociocultural learning support learning, which is embedded in the context of social relationships (Rogoff, 1990). Newman, Griffin, and Cole (1993) interpret sociocultural learning as development that is interrelated learning from the child's very first day of life. Vygotsky (1978) hypothesized that children have two levels from which they learn: the actual developmental level and the level of potential development. When children are engaged in a problem-solving task at either level learning has occurred or will occur. This space between these levels of learning is referred to as the zone of proximal development. It is now understood that learning and development are interrelated for children, and children learn best when working in their zone of proximal development (ZPD). This zone can be a place that the learner can function at a slightly higher level when the learning is scaffolded by a more capable other. The child can reach to higher levels of understanding as development trails along. Maximum benefit in learning takes place when this ZPD is embedded culturally.

Literacy learning in this way describes how readers and writers construct knowledge with hypertext. Hypertext requires the reader and writer to make intertextual links and the links can be defined as the meshing of categories of information to create new unique categories or ideas as defined by the discourse in which the reader or writer is functioning. To apply this intertextual knowledge, readers and writers draw upon knowledge of scripts, genres, social relationships, and practices. These elements all contribute to how texts are socially constructed within discourses to assert one's ideas (Beach, Appleman, & Dorsey, 1994). Barton (1994) asserts that all texts depend on earlier texts. This assertion assumes that within text lies the potential for new text and this also brings to light how language and text are closely linked by Bakhtin's (1981) notion of double-voicedness.

Creating literacy learning spaces provides a means for expressing oneself in ways that reflect more directly the complexity of our thinking and the interrelatedness of ideas (Reinking, 1995). As children create texts, they develop spaces for themselves and others just as an architect designs a space in a building. These spaces hold the potential not only for meaning, but also for an opportunity to understand a child's literacy development with a different type of lens. The architecture or engagement of these spaces provides for a juxtaposing of multiple texts that may achieve powerful ways of knowing and learning complex knowledge. According to Sprio, Coulson, Feltovich, and Anderson (1994), the multimedia nature of these forms of text being juxtaposed may afford a kind of semiotic engagement that provides students access to multiple symbol systems. Students might also be afforded ways of knowing that are metaphorical or through analogies.

Hypertext authoring and reading brings into play transactional reading and writing through the process of interpretation. Hypertexts are malleable things and in certain respects a hypertext can be re-authored each time someone enters it. The implication is that we must rethink our conceptions of reader and writer. Our notions of what literacy is must be broadened because technological developments are affecting the nature, processes and uses of literacy (Teale, 1997). Transactional reading theory is broad enough to include these new definitions; however, types of interpretation may change as a result of the ways readers and writers select stance.

Chase and Hynd (1987) list five possible perspectives that children must consider as they author: the teacher, other classmates, their own, a critics, and other children outside their classroom. Almasi (1995) suggests that there is actually a sixth interpretant: the changing interpretation within one reader when faced with challenges to their interpretation from the text or from others. Hypertext has the ability to engage readers and writers in the sixth level of interpretation because it is dynamic, often reflective and introspective. There are multiple interpretations with hypertext and readers must have tolerance for and even an expectation of ambiguity, which may cause them to rethink initial responses. The hypertext is viewed not as static but as dynamic and changing and readers learn to understand that a flexible use of stance is a necessary element in considering alternative meanings (McKeon, 1999). Flood and Lapp (1994) suggest that we need to expand our notions of reader-response to

include the communicative arts, which includes computer technology. Rosenblatt's (1994) explanation of how reader-response theory also supports writers is clearly flexible enough to accommodate these new definitions of literacy, which encompass hypertext authoring.

Method

The School

This study was situated in the context of a suburban elementary school in the Southwest. The school was within blocks of a university and drew students from the surrounding neighborhoods. Students who attended the elementary school were in grades kindergarten through fifth grade. Literacy education at this site was a focal point of the entire curriculum for all students who attended the school.

The school literacy philosophy assumed that all children entering school in the fall of their kindergarten year were readers and writers, whether they were emergent or fluent in their abilities. School media personnel supported the literacy philosophy by assisting the teachers in selecting books or materials for units, by teaching library and technology skills, and in generally supporting students as readers. Students selected books from the school library on a flexible schedule and students were often seen selecting or returning books before and after school. Students were also observed talking to teachers, the principal and the media specialist about a recent book they had read. The media center environment was traditional in the way it was organized; however, all books and materials were accessible to students. The school computer lab, a room within the school library, was the only area not totally accessible to the students. The library did contain three computer stations with access to the Internet.

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Setting and Participants

The Classroom

The classroom was structured to enhance literacy learning from a physical standpoint. The children had their desks in clusters of four to maximize collaborative learning. A classroom library housed a collection of nonfiction books and a collection of fiction books with a specific emphasis on history and historical fiction. There was a bathtub with pillows in it as a comfortable place to read along with a reading loft that was elevated six feet off the floor. Three computers and a printer were together on a table and one computer was connected to the Internet. One large table was used for student-led group projects while the other round table in the classroom was used for teacher and student conferencing during reading and writing workshop (Atwell, 1987). Multiple art projects and student-authored books were suspended from the walls and ceiling. One bulletin board contained torn art pictures reflecting feelings from the novel, *Number the Stars* (Lowry, 1989). Student writing was displayed in the classroom library and current themes, novels, or units being taught were directly connected to this.

Learning in this classroom was collaborative by design and structured by the teacher's constructivist, approach to teaching literacy (Lane, 1993; Rosenblatt, 1978; Tompkins, 1996; Vygotsky, 1978). Daily literacy learning focused on the reading and writing workshop model (Atwell, 1987). Learners were immersed in extended amounts of time to read freely alone or with a partner. While learners were reading, small groups of children met with the teacher to conference about the books they were reading. The class also took time to read a class novel together daily and reflected on the readings in a response journal. The response journals included writing or drawing prompts suggested by the teacher. The teacher responded to all responses written in the literacy journal with comments as a way to assess the students.

Visual literacy (Flood and Lapp, 1995) was a large part of the reading and writing processes that took place in the classroom. The teacher utilized art instruction as a way to connect meaning from what the children read into what they knew through a visual medium. The learners in this classroom utilized this type of meaning construction daily as a way to extend their learning within other sign systems.

The learners closely linked technology use and literacy learning because they were already experts at employing transmediation as a learning strategy. The classroom contained three computers with one of them networked into the district Internet connection. Learners used the computers in the classroom to play learning games or to find information on the Internet. Classroom use of the computers was limited and only three to four children per day could use them. The class visited the school computer lab once or twice a week and sometimes published their writing with the available word processing program. This limited amount of time each week was due to an insufficient number of computers available for use. However, while in the computer lab there were enough computer stations to accommodate an entire class. The fifth-grade participants were members of one classroom, and the focal children were chosen randomly from the group. The focal children were interviewed and contrasted with the entire class through field notes and observations.

The 20 class members had been divided by the teacher into dyads for the purpose of authoring throughout two hypermedia projects. The teacher's rationale for how she selected dyads was based on her knowledge of their personalities and writing strengths. She felt that certain children had great difficulty in working together and she wanted to specifically avoid personal conflict within the dyad. She also considered the child's writing strengths and tried to pair dyads based on what each could contribute to the collaboration as a strength. The eight focal children in the study were randomly selected from the ten dyads. Four dyads participated as focal children and they were contrasted with the entire class through field notes and observations. The focal group consisted of three female students and five male students. Pseudonyms have been used for confidentiality of the children.

The focal children in authoring dyads were Sean and Allison, Sue and Angela, Bryan and Taylor, and Jack and William. Sean and Allison were both avid computer users who had computers in their homes and Sean had previously authored with HTML. Sue and Angela also had computers in their homes with Internet access and both had participated in on-line chat sessions outside of school with each other. According to the teacher, Sue and Angela were considered expert writers both in the classroom and the computer lab. They also had a strong friendship that extended into their personal lives. Bryan and Taylor often found it difficult to author together since Bryan was able to fluently type at the keyboard. They were observed during three authoring sessions in heated discussions regarding who would type at the keyboard. Despite the differences in typing fluency Bryan and Taylor chose to write together. Taylor remarked during an interview that he trusted Bryan with his writing because he knew Bryan would not make fun of his ideas. Bryan had a computer in his home with Internet access; however, Taylor did not. Taylor would often go to Bryan's house

after school to use his computer. Jack and William were the quiet dyad. They were reluctant to express ideas during interviews and during writing workshop in the classroom. They were reflective with their prewriting documents and used the writing rubric to help them design the second project. Jack had recently gotten a computer in his home and often brought to school stories he had typed for others to read. William did not have computer access in his home.

Data Collection

Data collection focused on exploring the processes the children engaged in during two authoring tasks in hypermedia authoring environments. The first writing task involved the use of Hyperstudio (Wagner, 1993) as a tool to author a critical literacy project based on a novel, *The Giver* (Lowry, 1991). This program allowed the students to use multi-linear writing and it was used to introduce the students to notions of multi-linear writing before proceeding to HTML authoring. Hyperstudio also included word processing elements and the ability to add graphics, sound, and animations to pieces of text. The second writing task involved the collaborative writing of an HTML document with Pagemill (Adobe, 1997). Pagemill was used as an HTML editor so that the learners could write in multiple ways while they were free from writing HTML code. The program utilized word processing along with the addition of graphics, animations, quick-time movies, and sound. The second writing project was also tied to a chosen theme that incorporated three novels and a social issue selected by the children during a class discussion. The three novels read during reading workshop included: *The Giver*, (Lowry, 1991), *Number the Stars*, (Lowry, 1989), and *Roll of Thunder, Hear My Cry*, (Taylor, 1976).

Hypermedia authoring took place from mid-January through mid-May. The children evaluated each other as they presented their final projects to the class. While working on the Hyperstudio project, collaboratively, they created a writing rubric that incorporated elements of traditional writing and multi-linear writing. The students used this rubric to evaluate each other.

Data collection began with observations of the classroom literacy lessons three times per week. The first three weeks of field notes focused on the literacy context. During the first week I became acquainted with the children and took field notes about the context of the literacy instruction, noting social interactions of groups and how the children engaged in authoring. I met individually with the eight focal children and explained that they had been chosen to help me understand more about how children author with hypermedia. The identity of the focal children was not explicitly made known to the members of the class.

Data sources included extensive field notes of classroom literacy lessons and computer lab sessions, student prewriting documents, project changes at the end each of week of authoring, the student created writing rubric, final authoring projects, and three semi-structured interviews conducted with the eight focal children. The weekly writing changes, prewriting documents, and the semi-structured interviews only involved the focal children. The data were then compared with the field notes. Semi-structured interviews took place before

beginning the first authoring project and after the first authoring project, which used Hyperstudio (Wagner, 1993). The third interview took place at the end of the second authoring project. This triangulation of the interviews with the field notes, prewriting documents, and final projects the students used throughout the authoring process supported some understanding for the students' perceptions as they authored with hypermedia. The triangulation of the data also offered a lens used to peer into the child's perspective of how they believed that they may have grown as writers. Interviews were used as the primary data source and field notes, observations and writing artifacts were used as secondary sources of data to triangulate the data and add trustworthiness to the findings.

Data Analysis

Analysis as a Sense Making Process

Multiple methods of data analysis, which crossed research methodologies such as grounded theory, semiotics and discourse approach have appeared in the literature as a way to creatively answer questions (Berghoff, 1994; Fey, 1994 Labbo, 1996). Miles and Huberman (1994) suggested that it is this creative stance in analyzing data that makes the data a rich bed of information and that analytic problems can be approached in many different ways. A unique approach to analytic problems with data was illustrated in a study done by Smagorinsky and O'Donnell-Allen (1998) in which they used Peirce's (1933) triadic framework to construct a two tier coding system in conjunction with coding systems used in the cited literature. Smagorinsky and O'Donnell-Allen created a multi-method approach for understanding students' visual text contrasted with the students' own words. They sought to understand how students composed meaning from literature through creating interpretive texts.

Data Analysis Clarification

Analysis of the data, including the interviews and field notes, utilized the constant-comparative method (Glaser & Strauss, 1967) for a line-by-line analysis. Questions from the semi-structured interviews, were rephrased to inquire about similar topics in three different ways. This rephrasing of questions made it possible to triangulate the data and add internal consistency to the interviews (Miles & Huberman, 1996). Analysis of the field notes also utilized the same approach and added further triangulation to the analysis of the children's perceptions. Writing artifacts were analyzed through the use of memoing to summarize the final projects and matrices were constructed from the data based on the children's rubric they designed. The use of a matrix organized the data to draw some conclusions from the children's writing based on applying the rubric they designed to see if their described growth stated in the interviews coincided with their rubric.

All of the data were thoroughly read before open coding (Creswell, 1998) began. Initial codes were developed to characterize large themes in each of the interviews. Initial coding categories grew out of the questions from the interviews

but were later refined and written in the children's own words based on reoccurring phrases and words in the data that the children used during the interviews. Additional coding was done to further develop codes and tie themes together through relationships established by the theoretical framework. The coding of the data yielded six broad themes. Matrices of the artifacts were contrasted with final matrices from the interviews. The matrices from the artifacts were used to support initial findings from the interview data.

Findings

This research is the story of eight children and their perceptions of authoring with hypermedia over a period of five months. Included in the findings are the accounts of how the children believed they grew as literate people during the time of authoring. The children's perceptions of authoring with hypermedia yielded six broad themes: defining literacy, ways to write, collaboration, meaning construction, web writing and school writing, and ways I have grown as a reader and writer.

Definitions of Literacy and the Ways Hypermedia Impacts that Definition

All the children defined literacy in the study as the ability to read and write. Linear writing conventions were also included as part of their definitions and they included the ability to write using punctuation, spelling, choosing the right vocabulary to mean, and handwriting. The definitions of literacy were varied with regard to conventions of writing; however, definitions of literacy that included nonlinear writing conventions were consistent across all eight interviews. All of the children stated that being literate involved not only the linear ways, but also nonlinear ways that equated the ability to be a good writer with also being a good "techie." Those who were literate could not only manipulate text in a linear format, but also in a nonlinear way that suggested expertise with hypermedia tools. William elaborates on this idea as he describes writers in his classroom:

William: In our writer's workshop I sit and talk with three people who can't write on paper, but we all talk about how we can write on the computer really well. What I mean is that I can write a story or poem using a program like Hyperstudio, but I start with my drawings first and then add words. My friends say that this computer writing makes us better at it (writing). So as I learn the program I am getting better at writing.

Literacy Is

Literacy definitions were described by the focal children as reading and writing in a linear sense. Descriptions of knowing how to read, writing rough drafts, writing complete sentences, understanding who your audience was, and the school literacy club were examples cited by the children as the most prevalent ways to be literate. Other examples that were talked about by two of the students included storytelling, being open minded when trying to figure out a topic to read or write about, and reading to build vocabulary.

A typical response given when asked, "What is literacy?" was cited from Sean's

interviews:

Interviewer: What does the word literacy mean to you?

Sean: You have to know how to read. You have to have ideas in your head, and know who your target person is when writing, whether it's kids, about kids, toddlers or grownups.

Interviewer: Are you describing your audience?

Sean: Yeah, the audience, of your books you are writing. You have to go to what they are mostly interested in, go to that sector. You can't change the mood of your writing in the middle, it confuses everyone. You can't change the whole idea from chapter to chapter, it is important to carry your ideas all the way through the story. I've had problems with this. Changing the mood means you have to change chapters.

Interviewer: Why do you do this?

Sean: You eliminate confusions if you stay with your main topic in writing, but it is hard to do this sometimes with a lot of characters.

Sean elaborated on what he thought literacy was in terms of his own writing and also his experiences as a reader. This was cited as a typical example because in trying to define an abstract concept such as literacy, the focal children described situations of reading or writing that they had engaged in.

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Hypermedia literacy

Literacy definitions by all the focal children included twice as many nonlinear elements in their descriptions as linear elements. Literacy in a nonlinear sense was described as being able to navigate web pages and find the information you were reading for, writing with two hands, the ability to use the inspector (a tool bar) in Pagemill, knowing how to edit on the computer within each program, and grabbing graphics and animations from the Web to include in their writing. The children cited those who were extremely literate as those who knew how to include video and audio clips in their writing with ease.

Those who could function in the group as a technical consultant were also seen as highly literate individuals and their strengths were cited as part of how literacy was defined. Literacy definitions and descriptions of the "techie" did not imply that because one was a writing expert in a nonlinear sense, one was also an expert in a linear sense. In other words, according to the children, a writer could be proficient writing with nonlinear text and not be proficient with linear text. Six of the eight focal children expressed that one could be a poor writer in class with linear writing and be an expert at the computer and literate as a result of being able to manipulate writing with nonlinear conventions.

Literate people did not need to engage in prewriting or revise documents because this took place during the writing at the computer. The children expressed that since you had to see how it looked, prewriting was not a helpful step in writing. Revision of documents created shifts to include revision as a process that utilized trying out tools or experimenting with nonlinear conventions. The children cited nonlinear writing conventions most often as influencing how they defined what literacy was, and how these nonlinear conventions shaped literate people as writers. Nonlinear writing conventions differed from linear writing conventions in one distinct way, the nonlinear conventions contributed to meaning construction in contrast to linear writing

conventions, which usually do not (Graves, 1983).

The children cited several of the same examples of knowledge a literate person had to possess to author with hypermedia. The use of navigation buttons, where to get them, how to link and place them was given as the most important thing to know when authoring in this medium. Next, general knowledge of the tool that emphasized an understanding of the Pagemill (Adobe, 1997) inspector or Hyperstudio (Wagner, 1993) toolkit was important to author. And finally, utilizing backgrounds that made writing interesting without making it hard for the reader to read was cited along with using graphics and placing text around graphics to increase the reader's meaning process. These were all seen as a knowledge base for literate people to understand if they were to author with hypermedia tools.

Ways to Write

Ways to write were defined by the children as the media you might use to write with. Ways to write included pencil, pen, and computers. Hyperauthoring expanded their definition of ways to write to encompass not just writing tools, such as buttons and graphics, but also different types of text. These different texts included some they authored, audio text, their own voices recorded, and links to others' writing that they acknowledged as written by someone else; however, they included it as part of their writing. William's response was typical of how the dyads described ways to write.

William: I wanted to use the Mississippi flag and the Confederate flag on the web page so that when someone read the page they would see those flags waving and maybe know how hate was part of the life of these characters. Just what they had to deal with in the book Roll of Thunder and maybe the reader could feel what they, the characters, felt when they saw those flags.

Collaboration

Collaboration in this classroom was an integral part of learning for all the children. It was most often described as working together through talk. This description of learning through talk, according to Allison a focal child, best described how the focal group felt regarding their collaboration during the two authoring projects. Language use mediated by collaboration was clearly seen as a tool for learning (Smagorinsky & O'Donnell-Allen, 1998). Allison explained how this mediation of talk moved her own learning forward as well as that of her peers:

Allison: It is good to share your ideas and others' ideas and stuff, because they can help you by not even looking at the paper, you know, you can just tell them and they can help you write better. If there's a tough spot, they can talk you through it. Your partner can talk your idea, and add some to it, to make a really great idea. Our whole class does this during group conferences.

Planning Our Writing

The focal children engaged in prewriting and playing sessions as they learned the hypermedia tools. They worked in teams of two to collaboratively plan their writing on index cards and experimented with these ideas during their playing sessions in the computer lab. Planning their writing took place during the prewriting sessions in the classroom and it also extended into authoring sessions on the computer. Prewriting, as a writing stage, involved trying out tools and locating the ones that worked best for the project.

Other benefits from collaboration cited by the focal children included: sharing the writing experience, getting different views on a topic, and having an expert "techie" on the team to make the writing better.

Meaning Construction

Constructing meaning through writing with linear and nonlinear text was the teacher's goal for the two authoring projects. The children used the hypermedia tools to construct meaning from three different novels. They also used nonlinear conventions and tools that suggested multiple ways to write. They constructed meaning based on their perceptions of the process.

Meaning construction for the focal children was based on the three elements: talk, evaluation, and literacy relationships. The nonlinear conventions and tools provided through the hypermedia authoring helped to mediate the process as opposed to creating or shaping it.

Talk Is My Writing

"Talk is my writing" was always revealed as a way to construct meaning by the focal children. Sharing writing in groups or talking about writing ideas was viewed as the best way to start writing. Sean and James thought talking was the best way to begin writing; however, they expressed that talking to their teacher about their writing before meeting in groups was their preferred process. They elaborated on this by suggesting that they did not want to share their writing until it was completely finished. This was their common practice in the classroom; however, the computer lab screen was much more of a public space and they engaged in talk about their unfinished writing during authoring sessions, often acting as experts for other class members to collaborate with.

Web Writing and School Writing

The focal children expressed a dichotomy between authoring tasks in the computer lab and the writing within their classroom. School writing tasks were often completed for a grade and external criteria guided the writing. In contrast to the hypermedia authoring, school writing assignments contained those same evaluation elements for the students; however, the nonlinear writing conventions and tools afforded by Hyperstudio (Wagner, 1993) and Pagemill (Adobe, 1997)

allowed the learner to set a broader purpose for writing. This autonomy to set a broader purpose tended to create a clear distinction for the children between how linear writing differed from nonlinear writing.

Doing School My Way with Nonlinear Writing

In stark contrast to this notion of "doing school," one learner described nonlinear writing as a pie with many pieces you could manipulate, combine, or get pieces from other pies to make yours better. This student also described linear writing, in a metaphorical way, as particularly getting to eat one piece of the pie and equated this to the use of linear text to express all that he wanted to say.

The nonlinear writing, according to the students, was more interesting because they could use the tools to shape their writing by adding buttons, backgrounds, graphics, text, sound, and the ease of editing to invest in changes. Focal children consistently stated across all three interviews that nonlinear writing was more interesting, because you could write in different ways. This allowed them to feel that they were accomplished with their writing as a result of being able to manage the software. Ways to write more and to a deeper level were suggested through the use of graphics or music and then the use of text to explain what it meant according to the author.

Web writing and school writing differed in two additional ways according to the dyads based on traditional linear writing notions: first, they suggested that with web writing in the lab they did not have to revise, they simply made changes as they wrote. And secondly, they felt that the software did the writing for them because the tools suggested ideas or allowed them to combine ideas by mixing graphics, sound and text. Juxtaposing of multiple texts helped them create their own purpose for writing while still satisfying the "doing school" requirement.

Ways I have Grown As a Reader and Writer

What were the children's perceptions of their literacy growth as they authored with hypermedia? This question was the salient point in understanding how hypermedia authoring constructed the children's perceptions of authoring and to what extent it moved them along the writing continuum. Answers to the question were found in the ways the children described their reading and writing growth. Ways to write grew throughout the study to include notions of readability for meaning construction. Readability was defined by the focal children as types of authoring design that could either help or inhibit meaning construction from the reader's viewpoint based on how nonlinear writing conventions and tools were utilized.

Nonlinear Ways

The children's perception of their literacy growth as they authored with hypermedia was tied to the use of nonlinear writing conventions, tools, and

meaning construction. These three notions formed the basis for understanding why readability was seen as a sense making process for readers. Readability was couched in design for the purposes of making their documents accessible to all readers who might encounter them.

Nonlinear writing conventions were used as a way to make the writing easier to understand while not adding much to the content of the text. Examples cited by the dyads were the ability to write with both hands, spellcheck, grammarcheck, navigational buttons, boxed text to separate ideas, and being able to toggle between the World Wide Web and the authoring tool to see and try out new types of text. The ability to simultaneously manage a desktop, use the browser, and utilize authoring tools were also cited by four of the students as something they had gained within the realm of writing conventions.

All the focal children described tool use as a convention to enhance meaning construction as the single most important thing that they had learned. Examples of this included the description of characters in a story written with linear text and then the character was also described through the use of graphics to provide visual analogies for character traits. Additional uses of graphics included the use of flags to let the reader know and understand the mood of the novel explained. This use of flags conveyed sadness through the stated text and also the colors and symbols on the Nazi flag helped to explain how the dyad described the crimes of the German Nazis in Denmark. Lastly, audio was recorded to enhance the meaning of a theme in the Hyperstudio (Wagner, 1993) projects.

These descriptions of literacy growth represented how the tool mediated and extended their knowledge of writing processes to broaden and include multiple types of texts. Lastly, with regard to literacy growth, the focal children articulated that literate people were those who were also good "techies" and they all expressed that they had grown in becoming better writers through greater understanding of the hypermedia tools.

Discussion

The findings explore children's perceptions as they authored with hypermedia and their perceptions of their literacy growth as they authored with hypermedia. Themes that emerged from their perceptions dealt with changing definitions of literacy and literate people. Literate people were described as those who could read and write and also those who were exemplary "techies." Ways to write were described by the children through traditional medium, as well as, nonlinear medium. The children made a distinction between linear writing conventions, nonlinear writing conventions, and nonlinear tools. Tools were used as a convention, but also to help construct meaning. Examples of these meaning tools were sound, graphics, and animations. This data was consistent with ways that Tierney and Damarin (1998) describe shifting paradigms for how writing is constructed with digital tools.

Collaboration and talk were cited as the most important component needed to

author with hypermedia. Collaboration, group feedback, and the authoring of the multilayered writing rubric supported meaning construction. Labbo (1996) also found this talk and learning phenomenon to be an essential component for making meaning as children author with hypermedia tools.

Authoring school writing assignments in traditional ways and web authoring differed based on the purposes the children were able to set for themselves. Web authoring put at their fingertips more choices in being able to modify the writing purpose to satisfy their learning needs. The role of self was more apparent with Web authoring as the learners constructed their purposes based on their own voice and the voices of others melted within the documents (Bakhtin, 1981; Kamberelis & McGinley, 1992).

Literacy growth was noted in some linear ways through the writing conventions of spelling, punctuation, and capitalization. Nonlinear ways for literacy growth were described by the children through their use of flexible sign systems to extend traditional text and provide alternative meanings that were expressed in sound, graphics, icons, animations and text choices (Berghoff, 1994). As an example of growth, William, learned to mean in one way from what he understood regarding concepts of linear text, but later shifted his understanding as he gained proficiency in using Pagemill (Adobe, 1997). Learning to mean initially for this child was focused on a linear format of text that had a distinct beginning, middle and end with regard to story structure and may have included some pictures. The sign systems used to turn pages, icons, took on a different meaning as multiple icons and choices were added to his web page. He came to realize, as an author, he had little control over how readers would navigate the text (Eagleton, 1998). The learning that took place in this anecdote resulted from collaborative discussions and participation in the literacy event as the child presented his project and others evaluated it. This literacy growth event was formed in the ways he explained project one, with a warning label to navigate his text in only his prescribed way. Growth was seen in the way he stopped using this navigation warning in the second project and included multiple paths for readers with icons (Luria, 1983).

Semiotic sign systems were also used by all the dyads to construct meaning. The children wove their written texts in the ways they selected sign systems to mean (Labbo, 1996). Halliday (1977) described this as the dialogic construction of meaning. Learners used the sign systems available through the digital tools to take something known and tell it in new ways. Semiotically, the learner constructed an experience and when others came in contact with the shared experience they shared in the constructing. The meaning was "created by the impact between a material phenomenon and the shared processes of consciousness of those who participated in it" (Halliday, 1985, p. 75). A good example of this is the use of audio tracks and how to place them in pages. As groups of learners mastered this it became a shared experience and others learned as they joined in to understand the use of audio as a tool for meaning.



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The sign systems used indicated that the learners were aware that different kinds of audiences might encounter their writing, so dyads anticipated this through their use of multiple signs such as video, graphics, or audio. Rosenblatt (1978) described a similar phenomenon through transactional reading and writing theory, which sought to anticipate the voice and reaction of the reader as the writer authored. The sign systems indicated patterns that were repeated across both projects. This suggested that the sign systems used by the learners constructed a code, organized the writing through the sign structure, suggested choice, and related contrasts to convey a larger picture of the overall meaning construction (Manning & Cullum-Swan, 1992; Smagorinsky & O'Donnell-Allen, 1998).

Symbols and Social Relationships

The perceptions of the social relationships between the dyads were influenced through the sophisticated ways some learners navigated the use of hypermedia. Cultural capital was held by those who could manage sign systems that were very technical. Sean held this level of status within the class and other learners cited him as the "techie" of the class. Sign systems used by the children served multiple purposes: they represented the writer's understanding, the signs evaluated the existing cultural milieu, and created social relationships in the classroom (Pea, 1994; Wertsch, 1991). It is suggested that one reason the children limited the breadth of their writing may have been because of all they were trying to socially and cognitively manage, layered with learning new ways to write (Lemke, 1998). Many more events were taking place during these authoring sessions than simply reader-response activities and weekly computer time.

This study was exploratory in nature and not conclusive. The perceptions of expert writer as technology expert and nonlinear writing conventions and tools suggested some understanding of children's literacy perceptions as they

authored with hypermedia. The perceptions of authoring through developmental writing processes along with the use of semiotic systems and multiple ways to write provided insight into the children's perceptions of their literacy development as they authored with hypermedia. In understanding children's perceptions of literacy and technology as a tool, greater understanding for constructing pedagogy and curriculum that support new definitions of literacy may take place through new research. Lastly, the study raised many new questions that implied that research in the field of literacy and technology education is at an exciting crossroads to gain a greater understanding for how technology as a tool mediates literate thinking.

Limitations

Grounded theory can comprehensively help researchers build new theories; however, the application of new theories to practice is not always apparent. A study in a new area such as literacy and technology proposes some new theory, but the aim of the theory is to continue the inquiry and not to directly put new knowledge into practice. This is especially true in trying to understand literacy and technology theory combined. Meyer and Rose (1998) exemplified this point as they state, " It takes time to figure out how to use a new technology-to discover the valuable new uses implicit in the technology itself. At first, people tend to use new devices as if they were just different versions of something older and more familiar" (p.8). They cite the use of the wireless telegraph as an example of this and this innovation use actually turned out to be the present day radio. The point being that initial research with new technologies often has a tendency to appear as a new and improved version of the old when in fact with more research it is something quite different.

This research explores children's literacy perceptions in authoring with hypermedia tools as something different from traditional notions of literacy. Because grounded theory is context bound and difficult to replicate extending knowledge about how this might look in practice is difficult and time consuming. Some suggest that further study from a teacher research perspective is the best way to understand new definitions of literacy and this work may only provide a starting point for such research.

Implications and Conclusions

These findings suggest new ways that children understand literacy processes that take place both in and outside the school setting. Bolter's (1998) definition of hypertextual literacy emphasizing literacy processes that include both alphabetic text and a wider range of symbolic elements to mean could be suggested as a model for literacy learning which is broader. This new definition of literacy learning is useful as children engage in meaning construction through reader response with technology tools. A larger cohort of children in further research would help to explore these findings of changing literacy definitions from a greater sociocultural perspective. These findings also suggest that children see writing with electronic tools as very different from traditional school

writing tasks (Allington & Cunningham, 1995; Labbo, 1996). The children expressed that writing with hypermedia tools was useful because they not only practiced their writing but they also learned new programs and ways to write. Ways to write was a finding that included nonlinear text such as graphics, video, and audio.

New definitions of literacy were embedded in the children's perceptions of what literate people can do. They suggested that literate people can not only read and write, but they can also manage technology in sophisticated ways. These "techies" were described as people who could write with both hands, and utilize the computer as part of their meaning construction process while writing. If an individual was an expert with the ability to use digital tools then they were also good writers and very literate people. This was also consistent with Beach and Lundell's (1998) study that indicated that technological knowledge within authoring situations was extremely powerful for those who could manage it. Alvermann, Moon and Hagood (1999) noted a similar trend related to ways the children in their study described those who were literate. Adolescents in the study who could navigate more than eight windows between the desktop and the browser while participating in on-line conversations were viewed as highly literate because of their ability to use technology in a layered way. Clearly, the children in this research were beginning to understand the empowering effect of technology and this contributed to their changing definitions of literacy (Fey, 1994; 1997). Those who held this knowledge were considered in their authoring groups as experts and able to write well.

Literate people, according to the children in this study, can no longer simply read and write to be considered literate. Literate people must also create and mean with digital tools. Wells (1997) explains that learners now find themselves between convention and invention. They must learn to write with all the linear conventions that are part of our language, and also they must utilize invention as a way to mean. Invention involved the use of nonlinear text juxtaposed in unique ways to suggest new text.

In understanding children's perceptions of literacy and technology as a mix between convention and invention this research suggests that children already understand the complex ways that text can be layered and manipulated to convey greater meaning. Clearly, they viewed their literacy growth as tied directly to their understanding of digital tools along with other elements of literacy knowledge. Given these perceptions new research might begin to better understand how younger children begin to think about the conventions of writing as they learn to write and use computers before beginning school.

The children in this study gave some insight into how early literacy learning played a part in learning to write in new ways with regard to writing conventions and tools. The children reflected on how the linear and nonlinear writing processes differed; however, they were already fluent writers within the realms of linear writing. They understood a great deal about linear writing and based their perceptions on this knowledge. This idea leads to an interesting question in considering new research related to this study, in that, what are early literacy

learners' perceptions of linear and nonlinear writing as both of these processes are emerging? How might these processes interact with each other? And how do young emergent writers perceive their literacy learning growth while authoring with both linear and nonlinear text? The writing continuum for these young writers might include nonlinear dictation and text free web sites that could utilize many sign systems. These questions stemming from the findings of this research could form the basis of new research with emergent literacy learners to gain a greater understanding of how linear and nonlinear writing conventions may differ as defined by children.

Lastly, the children's changing definitions of literacy with regard to technology provide some troubling data related to their perceptions of what they think literate people and good writers need to know. According to the children in this study acting as "techies" implied that one was a good writer. This notion suggests that the children see the changing definitions of literacy as possibly phasing out the need for traditional writing conventions. It is also troubling in terms of access to technology and those who are most likely to have access. This may be a troubling implication for children in low socioeconomic status homes.

Given these new questions it is most obvious that literacy and technology research is just beginning to understand the consequences of integrating technology into the literacy curriculum. Clearly, more ongoing research is needed in the field to better understand how children perceive the use of digital tools as influencing their overall literacy perspectives.

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About the Author:

Sandra Goetze is an assistant professor of literacy education at Oklahoma State University in Stillwater, Oklahoma. Her research interests include children's perceptions of literacy learning as they use technology tools, wireless technologies for assessment in literacy education and computer mediated communication in preservice education. Sandra Goetze teaches undergraduate and graduate courses in literacy assessment and literacy and technology across the curriculum.

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