STUDENT INTERACTIONS WITH CD-ROM STORYBOOKS: A LOOK AT POTENTIAL RELATIONSHIPS BETWEEN MULTIPLE INTELLIGENCE STRENGTHS AND LEVELS OF INTERACTION

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By

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This study looked at the potential relationship that may exist between students’ intelligence strengths, in particular their spatial and kinesthetic strengths, and their combined cognitive and metacognitive levels of interaction with a CD-ROM storybook. The multiple intelligence strengths of a sample of students, measured via the MIDAS/My Young Child (Shearer, 1994-2002) was correlated with their levels of interactions with the CD-ROM storybook as measured by the researcher’s adaptation of a rubric used by Labbo & Kuhn (2000). It was predicted that correlational analysis would show different measures of positive relationships between all intelligence strengths but a higher positive relationship between both the spatial intelligence strength and combined cognitive and metacognitive levels of interaction with the CD-ROM storybook and also between kinesthetic intelligence strength and combined cognitive and metacognitive levels of interaction with the CD-ROM storybook. Results appeared to demonstrate that it was the unique student intelligence profile as an entity, as opposed to particular and individual intelligence strengths, in relation to the content of the storybook that was more informative concerning potential relationships at work.
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I do not stand alone in this accomplishment! I am in debt to so many who have taken this journey with me over the last several years. The resulting tapestry is a multifaceted whole yet composed of several important and integral threads that can be recognized as they glitter and shine throughout.

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CHAPTER I

INTRODUCTION

“Why use technology to support literacy learning? In truth, we do not have a choice if we want our students to succeed in the world in which they find themselves” (Valmont & Wepner, 2000, p. 5). Students in the 21st century no longer deal exclusively with the traditionally linear texts that have predominated the reading landscape for hundreds, even thousands of years. Similarly, the traditional notions of literacy as the ability to use and communicate with print texts are no longer those which prevail.

“Digital forms of reading and writing not only can be, but must be, integrated into the mainstream of literacy instruction for children in the elementary school . . . literacy is no longer a monolithic concept defined by print, pages and books” (McKenna, Labbo & Reinking, 2003, p. 273). Today, students are flooded with texts that are nonlinear as well as linear; print, nonprint and electronic as well as many others. Valmont & Wepner (2000) note that by the time children enter school, they have had access to multisensory instruction [and] have seen the world through various media. . . . These children’s classrooms are not the classrooms of past generations. Rather they are equipped to talk to the world and bring the world to the classroom through the Internet, CD-ROM (compact disc), DVD-ROM (digital video disc), laserdisc technology and interactive television. (p. 4)

For these reasons, as well as others not directly addressed herein, technology should be considered as a tool for literacy instruction within the early childhood
classroom. In true Vygotskian fashion, “our role, in fostering literacy learning with technology, often becomes that of facilitator, expertly guiding readers to appropriate online texts while taking advantage of the scaffolded learning supports embedded in many electronic environments” (Coiro, 2003). Though not an end in itself, computer technology has the capacity to scaffold children’s early reading experiences through not only its motivational capabilities (Matthew, 1997, National Reading Panel Report, 2000) but also through its ability to be sensitive to the differing intelligences children possess and as a possible result, the different ways and formats in which they interact with story. One example of this technology is that of CD-ROM storybooks. These storybooks are electronic versions of tales with pictures and illustrations that the child can read on the computer screen. The computer offers the potential to read the story aloud in a variety of voices with words highlighted as they’re pronounced and can also change the appearance of text or use background music or sound effects. Children can interact with objects on the screen via a simple mouse “click” as well as identify specific words for pronunciation and definition.

CD-ROM storybooks enable children to construct meaning from a text enlivened by animation, sound and graphics. Text is highlighted as it is read and helps the children to track the words visually from left to right and top to bottom as they’re read. In considering some of the crucial skills in learning language, we need to look at the applications evident for CD-ROM storybooks in the areas of listening, speaking and reading. These CD-ROM storybooks can provide an early listening and reading
experience that helps children develop both the skills and interest that will make them lifelong readers.

Reading experts (Adams, 1986 cited in Chu, 1995; Balajthy, 1988 cited in Chu, 1995; Matthew, 1996; McKenna, 1998; Miller, Blackstock & Miller, 1994) argue that technology is particularly critical for an increasing percentage of our population who don’t respond well to traditional print media and who are reluctant readers. The National Reading Panel Report (2000) found “agreement in the experimental literature that computer technology can be used to deliver a variety of styles of reading instruction successfully” (p. 6-9). Specifically, one of the implications they found was that reading instruction could benefit from multimedia computer software. The Report (2000) stated that “there appear to be many students who benefit from the addition of multimedia instruction to a conventional curriculum . . . when multimedia software is available and appropriate, it should be exploited” (p. 6-8). At the time of the report in 2000, the Panel found a dearth of research in the area of computer technology and reading instruction. One reason for this was the Panel’s perception that the general feeling by reading researchers was that technology was not a topic they considered in the mainstream of reading research.

Research on the use of electronic CD-ROM storybooks within the classroom and the support that they can potentially provide for students with various intelligence strengths is needed to assist in convincing teachers of the need to include these storybooks within their reading instruction. Considering the needs of the individual learner and their individual intelligence strengths or unique intelligence profile and
utilizing a blend of instructional strategies in reading and literacy development, including electronic CD-ROM storybooks, to respect those needs and differences is a call for the 21st century educator. “The cognitivist’s acknowledgement of different kinds of minds opens up enormous educational opportunities. If individuals do differ from one another and if we want to reach as many of them as possible, it makes little sense to treat everyone in a one-size-fits-all manner. Rather, we need to understand the specific minds involved in an educational encounter; and insofar as possible, we should base our education, including choices of technology, on that knowledge” (Veenema & Gardner, 1996, p. 3).

Additional research is needed to investigate how children respond to and interact with literature in electronic formats within the lens of multiple intelligence theory and also within related studies of differing learning styles and modalities. As we consider the learners in our classrooms and the different learning styles, preferences, modalities and intelligences they represent, the important question is to assure, within our capabilities, that they have access to literature in various formats to facilitate and assist them as they become multiply literate.

**Problem/Rationale**

Toward that end, the purpose of this study is to investigate and explore potential relationships between students’ levels of interactions with CD-ROM storybooks and their individual multiple intelligence strengths. Learning more about how young children interact with electronic CD-ROM storybooks within the lens of multiple intelligence theory holds great potential for maximizing reading instruction for the individual child.
This study hopes to be one empirical piece within a growing and continually evolving research puzzle.

**Research Questions**

Being a concurrent mixed methods study, there are two broad research questions addressed simultaneously throughout the study. The first is within a correlational perspective, and the second within a participant-observer case study model:

1. What is the relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their eight individual multiple intelligence strengths?
2. What apparent observed meaning making, from both the participant and researcher perspectives, is occurring within select participants individually as they interact with an electronic CD-ROM storybook?

**Research Hypotheses**

There were eight hypotheses that determined to show that (1) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their interpersonal intelligence strength, (2) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their intrapersonal intelligence strength, (3) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their kinesthetic intelligence strength, (4) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic...
CD-ROM storybooks and their linguistic intelligence strength, (5) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their math-logical intelligence strength, (6) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their musical intelligence strength, (7) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their naturalist intelligence strength and that (8) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their spatial intelligence strength.

Definitions

Being a mixed-methods research design, this design methodology is one modeled on the definition provided by Creswell (2002) as “a procedure for collecting both quantitative and qualitative data in a single study, and analyzing and reporting this data based on a priority and sequence of information” (p. 560). Blending both, a quantitative correlational research design and a qualitative case study/participant-observer design, this mixed-methods study becomes one that is primarily a concurrent triangulation design. Within this triangulation process both the quantitative and qualitative data are collected simultaneously, results are merged and the two data sets combined are analyzed to present a more complete view of the phenomena under study.

Within the correlational perspective, the relationship variables under study are those of the participants’ individual multiple intelligence strengths and the participants’
individual interactions with the CD-ROM storybooks. Multiple intelligences is defined according to Howard Gardner’s theory and includes linguistic intelligence, logical-mathematical intelligence, musical intelligence, spatial intelligence, bodily-kinesthetic intelligence, interpersonal intelligence, naturalist intelligence and intrapersonal intelligence (Gardner, c. 1999). That being said, the first variable under consideration in this study is the different multiple intelligence strengths of the students as measured by a version of the Multiple Intelligence Developmental Assessment Scale (MIDAS) (Shearer, c. 1994-2002).

The second variable of interest is students’ level of interaction with electronic CD-ROM storybooks. Interactions will be measured by a rubric with a theoretical base in Wittrock’s Generative Learning Model as adapted by Labbo & Kuhn (2000). Within this Learning Model, the construct of “attention” relates to what is attended to on screen, “motivation” considers why a child attends to particular features, “knowledge” to a child’s meaning-making processes and “generation” to how a child’s retelling of the story would reflect her story comprehension. For the intent and purposes of this study, only the first three of the Model’s components, attention, motivation and knowledge, will be of relevance as a measure of story comprehension was not addressed within the scope of this study. The interactions measured are defined by five major categories: attentive/perceptual (passive viewing versus clicking), affective (emotion, dramatic affect, musical response), cognitive (labeling description of action, wondering, summary statement provision, character commentary, plot commentary, theme commentary),
CD-ROM procedures (actual navigation or planning navigation through the electronic CD-ROM storybook) and metacognitive (predicting, confirming, intratextual connections, personal life connections, strategic access of media effects, misconceptions) (Labbo & Kuhn, c. 2000).

Within the participant-observer perspective, the researcher spent time with the students and teachers in their classroom developing trust and rapport. The researcher shared various formats of storybooks, assisted with classroom routines and activities and conducted timed observations with individual students as they interacted with the CD-ROM storybook.

This single case study focused on individual selected case analyses that were comprised of four exemplar cases of students representing very high and very low spatial and kinesthetic intelligence strength scores.

**Limitations**

Quantitative correlational studies, by their very nature, exhibit a relative weakness in establishing a cause and effect relationship, yet clear relationships may be observed between the variables under study. That said, internal validity of this study is still considered relatively low due to the lack of controls possible within a study of this design. Whenever multiple data gatherers are used, in this case and inescapably, the parents/teacher of the students in addition to the researcher, a certain element of validity is lost. No matter how well participants are trained to accurately gather and represent the information at hand, human nature is an unpredictable element that cannot be controlled and compartmentalized. Statistical relationships that may evolve between the variables
could also be due to the history surrounding the study rather than the existence of actual valid relationships.

In relation to qualitative research paradigms, Borg (1989) considers not only history, as mentioned above within the quantitative context, but also maturation of the study subjects and the changes that naturally accompany such, loss of study subjects through experimental mortality and instrumentation as the strongest internal validity threats within this context. The researcher’s use of a standard observational rubric for the instrumentation should facilitate consistency and, as the single recorder of data, a careful, consistent recording of observational data gathered. Additionally, the fact that the relative brevity of time involved, with the duration of the study falling within a two month inclusive time frame, should reduce, though not totally eliminate, concerns about instrumentation, maturation and experimental mortality.

**Methodology**

**Research Design**

This is a mixed-methods research design that attempts to explore the potential relationships between Kindergartners’ eight individual intelligence strengths and their combined cognitive and metacognitive levels of interaction with an electronic CD-ROM storybook. This design methodology becomes “a procedure for collecting both quantitative and qualitative data in a single study, and analyzing and reporting this data based on a priority and sequence of information” (Creswell, 2002, p. 560). Blending both a quantitative correlational research design and a qualitative case study/participant-observer design, this mixed-methods study is primarily a concurrent triangulation design.
in which both the quantitative and qualitative data are collected simultaneously, results are merged and the two data sets combined are analyzed to present a more complete view of the phenomena under study.

To represent quantitative data, a correlational study design was chosen because as a part of the broader research tradition known as comparative research, these studies allow for the examination of potential relationships between the variables under study. Within the correlational model, there were eight hypotheses that determined to show that (1) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their interpersonal intelligence strength, (2) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their intrapersonal intelligence strength, (3) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their kinesthetic intelligence strength, (4) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their linguistic intelligence strength, (5) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their math-logical intelligence strength, (6) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their musical intelligence strength, (7) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with
electronic CD-ROM storybooks and their naturalist intelligence strength and that
(8) there was a linear relationship between students’ combined cognitive and
metacognitive level of interaction with electronic CD-ROM storybooks and their spatial
intelligence strength.

Inherent within the study is the expectation that participants’ personal individual
intelligence strengths will individually vary and this variance could show greater or lesser
positive linear relationships that potentially demonstrate differing interactions with the
CD-ROM storybooks that affects both quantitative frequency and qualitative variances in
combined cognitive and metacognitive levels. The combination of visual and verbal
representation of content in the CD-ROM storybooks as well as their interactive hands-on
capabilities may have the capability to enhance or detract from the combined cognitive
and metacognitive response of students possessing specific intelligence strengths.

Time sampling and frequency-count recording observations of these interactions
will provide not only quantitative data for the rubrics but also qualitative descriptions of
how individual students bring meaning to the CD-ROM storybook viewing/interaction
experience. Combining both descriptive data gained from qualitative observation with
the correlations of the participants’ individual intelligence strength scores with the rubric
interaction scores will triangulate the data and provide a more complete description and
analysis of the data; one that Miles and Huberman (1994) describe as “a very powerful
mix” (p. 42).

Case study designs do not hold inherent implications for particular data collection
models (Yin, 1994) and hence provide a standard of flexibility within mixed-method
A single case study design was selected within this concurrent mixed-methods study in order to provide an alternative venue for classroom data collection and analysis. This will occur through a lens examining possible relationships between embedded pre-defined student exemplars’ intelligence strengths and their combined cognitive and metacognitive interactions with CDROM storybooks cases and these in relation to the specific theoretical hypotheses as set forth within this study. Tellis (1997) states that “the quintessential characteristic of case studies is that they strive towards a holistic understanding of cultural systems of action…(which) refer to sets of interrelated activities engaged in by the actors in a social situation” (online). The interrelated cognitive and metacognitive meaning-making activities of the child actors with their individual intelligence strength profiles in relation to their interactions with CDROM storybooks is the cultural system of action that is of interest within this study. In addition, the multiple perspectives of the children, their parents and teachers, as well as the researcher, provides for the varied multi-perspectival analyses inherent within case studies.

Within this case study model, the quantitative data gathered for each student will provide differing levels of information from which a few selective exemplar student cases will be chosen. Analysis of these exemplar cases will provide more in-depth information and a venue from which the theoretical stances of this study can be examined more closely.
Sample

In terms of maximizing both internal and external validity considerations probability sampling involving random selection has been held as the acceptable standard. However, within educational environments, human subject consent constraints result in what Borg (1989) describes as the entirety of educational research being conducted via the use of volunteers. With that said, it becomes evident that a modification or substitution for probability sampling will most likely occur in a number of research settings. The reverse of probability sampling is that of purposive sampling.

‘The logic and power of purposive sampling lies in selecting information-rich cases for study in depth’ (Patton, 1990, p. 169) with an underlying focus on intentionally selecting specific cases that will provide the most information for the questions under study’ (Kemper, Stringfield & Teddlie, 2003, p. 279). Though traditionally used frequently within the smaller sample sizes found within the qualitative research tradition, purposive sampling techniques are also found and used quite commonly within mixed-methods studies as well (Kemper, Stringfield & Teddlie, 2003).

In this particular study, it was perceived, based on personal in-depth experiences within a university based technology classroom during the pilot study, that the population chosen would be one of those specific information rich cases to provide the information needed for the research questions posed by this study. With this in mind, the population of interest within this study are two classrooms of five year old Kindergarten students within the Midwest of the United States. Correlational studies typically utilize a minimum of 30 as a reliable sample size (Creswell, 2002). The classrooms in question
would provide the necessary numbers of students to meet this reliability requirement. Within this population, the researcher employed random purposive sampling to extract a random sample of sixteen students from within each classroom population for detailed one-on-one observation. This technique served to add an element of trustworthiness to the findings and help to explain why certain cases were chosen for more detailed observation and study. In addition, specific quantitative data obtained through research instruments within the study was used to select exemplar students from this sample for more in-depth study as embedded units of analysis.

**Instruments**

Students’ individual intelligence strengths was assessed via use of the Multiple Intelligence Developmental Assessment Scales (MIDAS) (Shearer, c. 1994-2002). Due to the young age of the participants, a particular version of the assessment instrument, MIDAS-KIDS/My Young Child, was used. This version is in the form of a structured interview with the parent or between parent and child and consists of seventy questions that assess parents’ perceptions of Gardner’s (1999) eight multiple intelligences; spatial, kinesthetic, linguistic, logical-mathematical, intrapersonal, interpersonal, musical and naturalist intelligence strengths, as represented within their child.

The CD-ROM storybook selected for this study, *Stellaluna* (Random House-Broderbund, c.1996), was chosen because of the textual qualities it embodies. Textual analysis demonstrated it to be a “considerate text”, one which facilitates a child’s story understanding and recall through multimedia features holding a strong and supportive relationship to the story structure itself (Labbo & Kuhn, c. 2000).
Students’ level of interactions with the selected CD-ROM storybook were evaluated according to the Wittrock Generative Learning Model as used and applied by Labbo and Kuhn (c. 2000) within their research. This model (Appendix) is represented by five categories of possible student response to CD-ROM storybooks, attentive/perceptual, affective, cognitive, CD procedures and metacognitive. Within all of the observational analyses the combined cognitive and metacognitive level of interaction was scored via the child’s interactions with the CD-ROM storybook defined via cognitive activities such as labeling, describing action, wondering, providing summary statements, and commenting on characters, plot and theme plus metacognitive activities such as predicting and confirming behaviors, intratextual and personal life connections and the strategic access of media effects. The original instrument was used within a qualitative case study design.

For the intent of this study, this qualitative model was adapted by the researcher to provide a means of assessing level of interaction via providing ordinal scale data for each of the five categories. During timed observations, each student response/interaction during the use of the CD-ROM storybook will be recorded by the researcher with a tally mark and assigned within the appropriate category on the instrument.

The individual cognitive and metacognitive categories are of particular interest for the rich qualitative description opportunities they provide for the specific student interactions. Even so, as noted in Labbo and Kuhn (2000), the researcher decided to approach the quantitative ordinal data gained from student observations within both the cognitive and metacognitive categories in a combined manner. For this purpose, looking
Reliability and Validity of the Measures

In terms of validity and reliability, strong internal consistency for all eight scales of the MIDAS-KIDS/My Young Child (Shearer, c. 1994-2002) has been reported. Reliability estimates range from a low of .76 to a high of .87. Construct validity was reported with an inter-scale correlation range from .43 to .79 and a mean of .62. Overall, the strength and pattern of correlations for concurrent validity tests yielded statistically significant results. MIDAS scales were compared with scores children received on the Wechsler Intelligence Scale-Revised (WISC-R). Correlations between the Linguistic Scale and Verbal IQ were r=.60 and between the Logical Scale and Full Scale IQ were .54. Predictive validity showed high mean scores ranging from 59-73% with a mean of 63%. Low group means ranged from 42-50% with a mean of 40%. The author suggests that these are within an expected range that predicts that a score of 60% and above is considered high and 40% and below considered low range.

The *Stellaluna* (Random House-Broderbund, c. 1996) CD-ROM storybook was selected for this study based on its determination as a “considerate text”. The validity of this selection arises from a textual analysis found within a qualitative research study (Labbo & Kuhn, c. 2000). Though reliability and validity of instruments are determined differently in qualitative than within quantitative research, the researchers demonstrated these constructs within certain procedures that they followed. Their textual analysis
procedures involved two CD-ROM storybooks which could be interpreted as falling within the category of data triangulation. They also built this analysis upon the existing and respected theories of other researchers detailed within their study. Constant-comparative analysis also assisted in their instrument creation. The inter-rater reliability on their instrument was 91% agreement. Analysis of the coding sheets for their instrument showed distinct patterns of relationships that enabled them to make a distinction between *Stellaluna* (Random-House-Broderbund, c. 1996) and the other CD-ROM storybook under analysis and provide the designation of considerate versus inconsiderate text. Reliability was demonstrated within this qualitative process partially through detailed methodology, prolonged engagement and persistent observation, clearly stated questions and the pursuit of answers and a predetermined focus for this part of their study.

Phase Two of Labbo and Kuhn’s research (2000) involved a case study of a Kindergarten student interacting with *Stellaluna* (Random-House-Broderbund, c. 1996) and another CD-ROM storybook. This case study generated their adaptation of the Wittrock Generative Learning Model (Appendix) as a lens for evaluating a child’s response to/interaction with CD-ROM storybooks. Measures of validity and reliability in qualitative studies differ from those found in quantitative research. A few evaluative strategies that may be used to gauge validity here is to recognize that this particular study was one within a broader educational context that they were researching and was presented in such a way that facilitated their research being used and replicated by others. Another strategy to consider in measuring validity within the qualitative genre is to note
that their work is well documented and that their instrument appears to be accurate within previous respected theories of learning and instruction, much as was true with their textual analysis. In addition, they noted the limitations of generalizability within their study as a whole. Reliability here was gauged via their prolonged engagement and persistent observation of one year’s time at the research site and within which this instrument was adapted and tested. Additionally, the instrument creation was detailed with a clear path of logic and focal questions clearly stated from the onset of the research.

In terms of case studies, Yin (1994) considers construct, internal and external validities and reliability to be key test components for these study designs. Construct validity concerns instrumentation used within the study and its ability to accurately communicate and relate data measurements. One way for a better assurance of data integrity is to plan multiple measures of data within the study design. Within this study, quantitative and qualitative observational data collection via the rubric protocol will be supported through videotaping the computer screens and capturing both student computer navigations and verbal interactions during the timed observations. Another multiple measure built into the study design is the MIDAS instrument completion by both parents and teachers. This will provide an opportunity to triangulate and compare student profile data garnered from each perspective on the individual children within the study.

Internal validity of case studies is improved, and achieved, through multiple strategies which include “the specification of the units of analysis, the development of a priori . . . theories and the collection and analysis of data to test…(these theories)” (Yin, 1994, p. 136). Within this study, the units of analysis are the Kindergarten classrooms
and then within these single cases, the embedded analysis of the exemplar students selected by the specific criteria delineated. Theoretical hypotheses have been developed and stated speculating that relationships of potentially varying measures exist between specific intelligence strengths and combined cognitive and metacognitive interactions with CD-ROM storybooks. External validity within case studies is present within the “specification of theoretical relationships from which generalizations can then be made” (Yin, 1994, p. 136).

Reliability within case studies is demonstrated via use of established formal protocols (Yin, 1994) which help to assure that the same procedures are followed within each incidence of the case study. Within this research design are established procedures for exemplar case selection as well as formal protocols for data collection and data analysis. Pre-established and selected specific quantitative and qualitative data instrumentation measures are consistent for all student, parent and teacher participants. In keeping with good research design, these strategies are employed in an attempt to assure the reliability of the study results.

Timeframe and Procedure

This study took place during March-May 2007 and continued for approximately eight weeks. In one of the classrooms, entry was gained via a second contact with a professional colleague who is an Administrator at the school to ascertain what additional and appropriate school system contacts should be made prior to the actual research. Initial contact was made earlier in 2006 as the researcher discussed the generalities of the pilot study and the Administrator colleague expressed interest in having the
Kindergartners in her technology-rich school participate within the dissertation research context. Entry was gained in the second classroom via contacts with the Center Director and classroom teacher with whom the researcher previously collaborated during a Fall 2005 pilot study within their Center.

The researcher met with the Administrator, Director and teachers at both locations and provided them with letters, within which the research process was explained fully, to distribute to the students’ parents. Parents’ were also given information on the use and administration of the MIDAS-KIDS/My Young Child instrument (Shearer, c. 1994-2002). Parents were asked to complete the instrument by responding to the instrument questions directly according to their beliefs of their child’s abilities for each of the questions and return these results to the teacher within one week. The researcher acquired the completed instruments and assessment results were scored not only by the instrument creator, Dr. C. Branton Shearer, via scanned data sheets, but also scored manually by the researcher via data insertion into an online MIDAS assessment and administration tool.

Participant observation allowed the researcher to have immediate and personal involvement in the social world chosen to study; in this case a Kindergarten classroom. During the duration of the study, participation consisted of the researcher’s presence within the classrooms for portions of two days per week over eight weeks. Part of this time was used to become acquainted with the children, teachers and classroom practice as well as to gradually present to the children a sequential introduction to storybooks in electronic formats. The researcher shared print storybooks during each visit including Janell Cannon’s Stellaluna, the print counterpart to the electronic storybook. The
researcher eventually shared the *Stellaluna* CD-ROM storybook large screen with the group during a circle time meeting to role-model electronic storybook conventions and to demonstrate for the children the possibilities available when they would use the storybooks independently on classroom computers. After this group sharing the *Stellaluna* CD-ROM storybook was loaded on all classroom computers for independent free choice use by the students.

After two weeks of classroom observation and participation, the researcher spent the following six weeks observing sixteen randomly selected students within each group using the *Stellaluna* CD-ROM storybook individually for 30 minutes each. During these 30 minute sessions, students were asked to read/interact with the “Play With Me” version of the *Stellaluna* (Random-House-Broderbund, c. 1996) CD-ROM storybook on their computer workstation. Each of these individual sessions were videotaped from the rear to document interactions on screen.

Data gathered during these observations was correlated with data from the MIDAS-My Young Child instruments completed by the parents. Analysis of both the quantitative correlation results and the qualitative observational data were conducted with data gathered triangulated and analyzed as a singular informational set.

One of the important criteria used in selecting classrooms for this study was the availability of and student access to, and facility and comfort with, computer technology within the Kindergarten classrooms. It was perceived that structured interviews with the classroom teachers concerning their feelings about and philosophies concerning the use of computer technology within their classrooms would provide an informative context for
the study and its results. Each teacher was interviewed using a thirteen question structured protocol (Appendix).

As a central focus of the case study design, exemplar cases for extended study and analysis occurred via the selection of two students possessing spatial and kinesthetic intelligence scores falling in the very high range as well as two students possessing spatial and kinesthetic intelligence scores falling in the very low range on their MIDAS/My Young Child profiles. These student exemplar cases were further analyzed in triangulation with their descriptive qualitative data to determine if patterns emerged that might provide evidence for support of hypothetical stances within the study. These stances theorize the existence of stronger more positive relationships between spatial and kinesthetic intelligences individually and the respective student combined cognitive and metacognitive interactions with a CD-ROM storybook.

**Summary**

In summary, this mixed-methods study looks at the potential relationship that may exist between students’ eight individual intelligence strengths and their combined cognitive and metacognitive levels of interaction with a CD-ROM storybook. The eight multiple intelligence strengths of a sample of thirty-two Kindergarten students, measured via the MIDAS/My Young Child (Shearer, 1994-2002) instrument was correlated with their levels of interaction with a CD-ROM storybook as measured by the researcher’s adaptation of a rubric used by Labbo and Kuhn (2000). Additionally, qualitative data gathered through the individual observations was triangulated during data analysis to create a more complete view of research results.
It was hypothesized that this triangulated data analysis would show different measures of both qualitative and quantitative relationship between interpersonal, intrapersonal, kinesthetic, linguistic, math-logical, musical, naturalist and spatial intelligence strengths individually and the participants’ combined cognitive and metacognitive level of interaction with the CD-ROM storybook. It was further hypothesized that selective case study analysis of exemplar cases would show emergent patterns that demonstrate the likelihood of a stronger positive relationship for students with very high spatial and kinesthetic intelligence strengths individually and their combined cognitive and metacognitive levels of interaction with the CD-ROM storybook.

Correlational analysis was completed for each of the hypotheses and found that minimal linear and statistically significant relationships existed between six of the eight data sets. Two had minimal but statistically significant relationships. The case study analysis of four student exemplars provided data on a variety of unique approaches and masteries by the individual children observed and offered additional information concerning individual meaning making and potential relationships between student responses to electronic CD-ROM storybooks and their multiple intelligence strength scores. Three separate data analyses; that of observational data, correlational relationship data and cross-case data were conducted and will be discussed within the chapter on data analysis.
CHAPTER II

REVIEW OF THE LITERATURE

CD-ROM storybooks are electronic versions of storybooks that feature pictures and sometimes animations that the child can read on the computer screen. The student has an option to hear the story narrated in a variety of naturalistic voices and individual words are highlighted during pronunciation. The CD-ROM storybooks occasionally change the appearance of text and use both background music or sound effects, depending upon the storybook viewed. Children have the capability to interact with objects/hotspots on the screen via simple mouse “clicks” and can identify on demand specific words for scaffolding assistance with pronunciations and definitions.

These storybooks facilitate the meaning-making capabilities for children as they interact with varied texts brought to life through animation, sound and graphics. Children are empowered in their literacy development through text that is highlighted as narrated and this provides a scaffolding support for children as they track words visually on screen from left to right and top to bottom as they’re read. Researchers are currently beginning to consider applications evident within CD-ROM storybooks for growth within an integrated language arts approach to literacy development in the early years. When considering crucial skills in language learning, CD-ROM storybooks can provide early listening and reading experiences to assist children in their development of both skills and interest necessary toward their metamorphosis into lifelong readers.

Reading experts (Adams, 1986, cited in Chu, 1995; Balajthy, 1988, cited in Chu, 1995; Matthew, 1996; McKenna, 1998; Miller, Blackstock, & Miller, 1994) continue to
argue that technology is critical for an ever increasing population who don’t respond well to traditional print media and who also may be reluctant or struggling readers. Additional research is needed to investigate how children respond to and interact with literature in electronic formats. Research in the areas of reader response with digital devices (Larson, 2010); decoding and comprehension supports provided by e-Storybooks (van den Broek et al, 2009; McKenna & Zucker, 2009); multimedia presentations of learning and dual coding (Bus et al, 2009; Neuman, 2009); eye tracking and eStorybooks (Evans et al, 2009); and new approaches to storybook reading (Bus et al, 2009; Labbo, 2009; Shamir & Korat, 2009) are a few points of beginning. As researchers consider the multiplicity of learners in our classrooms and the different learning styles, preferences, modalities and intelligences they represent, the important challenge is to assure, within our capabilities, that learners have access to literature in various formats, and in some cases multiple platforms, to facilitate and assist them as they become multiply literate.

Toward that end, the purpose of this study is to investigate and explore potential relationships between kindergartners’ levels of interactions with CD-ROM storybooks and their individual multiple intelligence strengths. Learning more about how young children interact with electronic CD-ROM storybooks within the lens of multiple intelligence theory holds great potential for maximizing reading instruction for the individual child. This study may provide one empirical piece within a growing and continually evolving research puzzle.

This overview of research is divided into four sections and will begin with a look at the history of the use of computer technology within reading instruction. Following
this historical perspective is a look at the research surrounding electronic CD-ROM storybooks. The concept of multiplicities comprises the next section and includes research studies focusing on semiotics and multiple sign systems, dual-coding theory and multiple literacies. Finally, an overview of research covering multiple intelligence theory and its applications will be presented.

In order to more clearly recognize the necessity for this research study, it is important to look at the role that computer technology has played historically within reading instruction. The first section of the literature review will begin to explore the studies that fall within this informational context.

**Overview of Research on the History of the Use of Computer Technology within Reading Instruction**

As we begin our exploration into the history of the use of computer technology within reading instruction, let’s pause and consider that simple, mundane objects such as pencil and paper, technologies themselves, are also implements or tools that assist in the production of additional technologies such as writing and printing, the foundation for reading and reading instruction. Similar text-based instructional technologies such as chalk-boards, textbooks, workbooks, work sheets and overhead projectors facilitate and serve similar purposes. Initially, the integration of computer technologies by teachers within reading instruction was simply a reification of these text-based technologies. As with their earlier counterparts, all were used in support of traditional lectures, recitation and seat work, and all emphasized a didactic teacher (or computer)-driven instructional style. (Balajthy, 1989; Mason et al, 1983)
Over the approximately 40-year history of research on the use of computer technology within reading instruction, this instructional application and integration has been realized and represented within the literature in a variety of different ways. Probably the widest and most frequent representation was that of the computer’s use as a tool to facilitate teaching and drilling in specific reading skills. In addition, the use of computer technology to facilitate record-keeping and increase student motivation and engagement were also popular functions discussed in the literature.

1960s

We trace the beginnings of computer technology’s use within reading instruction to the mid-1960s with various research initiatives that emanated from several institutions of higher learning. The initial plans of researchers at Stanford’s Institute for Mathematical Studies in Social Sciences were to create a reading curriculum totally independent of teachers. In this case instruction would become completely computer-monitored resulting in a minimization or complete supplanting of the role of the reading teacher (Balajthy, 1989; Mason et al, 1983).

With the financial origins having their genesis in a federal grant, this beginning computerized reading program was a prime example of programs later categorized as Computer Assisted Instruction (CAI). In its operation, students were presented with six different strands of reading tasks which included Reading Readiness, Letter Recognition, Sight Word Vocabulary, Spelling Patterns, Phonics and Comprehension. Students interacted with computer screens using light pens to indicate their choice of response, with their answers immediately evaluated and the next, individually appropriate level of
instruction prescribed. Though the activities were successful within the original research plan, this individualized instruction without teacher intervention became cost prohibitive. Field trials also demonstrated that teacher support was necessary. As a result, the original plan was modified to include a similar computer assisted instruction package, but this time one in which the computer became a supplement to classroom instruction rather than an all-inclusive instrument. Teachers determined the amount of time students spent daily with the computer instruction and also received computer generated reports so that instructional decisions could be made by the teacher for the individual student. (Balajthy, 1989; Mason et al, 1983)

1970s

National Science Foundation funding assisted the Illinois Computer Based Education Laboratory’s development of the PLATO Early Reading Curriculum in 1971. At this point, it became clear that Stanford’s initial goal of supplanting teacher based reading instruction with that of the computer was not an instructionally sound one. From the beginning, PLATO’s plan to build a complete K-6 computer based reading curriculum included the use of a variety of instructional modes that facilitated teachers’ being able to work within their own personal reading instructional style. Over 1500 different exercises facilitated student practice in areas such as letter discrimination, word detail, memory skills, letter names and sounds, alphabet skills, high frequency and enrichment sight words, word meanings, sentence building, story reading and writing and timed readings. In all of these activities, the teacher was central in determining and prescribing computer based activities for each individual student and also receiving
feedback from the computer system concerning student progress (Balajthy, 1989; Mason, 1983).

Around the same time, with the facilitation of an ESEA Title III grant, the Florida State University’s Computer Applications Laboratory developed the DOVACK (differentiated, oral, visual, aural, computerized, kinesthetic) model. Similar to a language experience approach, students would dictate stories to a teacher who subsequently recorded, redictated and typed the child’s story on the computer. In an overnight process, the computer printed the child’s story which the teacher used for individualized instruction and evaluation. This program, as the Stanford one, was cost prohibitive and not continued by participating schools. (Balajthy, 1989; Mason et al, 1983).

During this time, textbook publishers also became involved in producing computer assisted instructional materials for schools. One example, Harcourt Brace Jovanovich’s drill and practice CAI Elementary English and CAI Remedial Reading (1967-1971) programs, provided teachers with computerized lessons on topics easily integrated within their personal lesson plans. Teacher driven, these lessons could be prescribed for individuals or the classroom as a whole. Though student gains determined through testing were excellent, associated hardware costs were prohibitive and the CAI programs were discontinued by the publishers. (Balajthy, 1989; Mason et al, 1983).

Computer Managed Instruction (CMI) programs also arrived in the 1970s. In addition to the services and capabilities of the older Computer Assisted Instruction systems, Computer Managed Instruction programs provided tests based on performance
objectives, scoring and reporting done by the computer and computer driven prescriptions for students. Teachers decided whether and how often to give the computer tests with computers working in consort with the teacher as advisor and prescriber. These packages did not differ substantially from the philosophies embodied in the previous computer technology systems in that each were heavily drill and practice oriented with teachers using the computer technology as an adjunct rather than an integral part of the classroom instruction. In essence, the computer did the “grunge” work that freed the teacher for other more “important” instructional activities. Computer assisted and computer managed instruction packages were also used to diagnose reading problems and prescribe remedial instruction and materials. Unfortunately in all of these programs, though, computer technology integration within reading instruction was often a top-down decision imposed upon classroom teachers by administrators. Practitioner based decisions jointly constructed, investigated, welcomed and embraced by classroom teachers was rarely experienced. In essence, those whose lives would be most heavily impacted by computer use in the classroom setting were not involved in these important instructional decisions. (Balajthy, 1989; Mason et al, 1983; Reinking & Bridwell-Bowles, 1991).

1980s

This top-down approach shifted somewhat in the early 1980s as teachers had more of a voice in both computer use in the classroom as well as in the design of reading instruction software. It became very clear to teachers and researchers that the computer would not supplant the teacher, but rather would “present much of the drill and take care
of the extensive individual record keeping which is the bane of . . . teachers who individualize instruction” (Mason et al, 1983, p. 192). In fact, Balajthy (1989) reported that “elementary school teachers using computers reported that drill-and-practice activities accounted for 73 percent of computer time, and tutorial instruction an additional 24 percent” (p. 84). In all of this innovation, computer technology was still very much an extension of traditional classroom instruction with teacher as originator and prescriber of practice in isolation.

As the use of computer technologies in reading instruction gained momentum, Reinking and Bridwell-Bowles (1991) note the parallel inclusion, as of the mid-1980’s, of separate chapters or sections on the use of computers in pre-service teacher reading instruction textbooks, the publishing of a number of books focusing on helping teachers become comfortable with the idea of using computers within reading instruction and, as well, attention from national associations such as the International Reading Association and the National Council of Teachers of English as they witnessed the growth and development of specialized interest groups and standing committees on the use of computers in reading instruction. These combined phenomena appeared to act as indicators to suggest that computers were considered an important factor in reading instruction.

With this additional information and support, teachers, with computers in their classrooms, as well as reading specialists made recommendations for how the technology could be better used to maximize student learning. Hardware improvements reduced the costs that were earlier so prohibitive. As a result, the use of computers in reading
instruction began to increase and accelerate. Software limitations, though, continued to lead to teacher disenchantment in using computers within reading instruction. Though reading philosophies began to switch in the late 1970s from those more linear and sub-skill based toward one more integrated and psycholinguistic in nature, the software publishers did not keep pace, rendering their software often inappropriate for reading instruction within this newer model. More sophisticated software designs brought controversial game based software, which depending on its use, was perceived as either a boon or bane within instruction, computerized speech synthesizers which read printed text aloud and various word processing programs which facilitated teachers’ integrated language arts instruction (Balajthy, 1989; Reinking & Bridwell-Bowles, 1991).

The 1980s also brought the Apple Classroom of Tomorrow (ACOT) Project and along with it the birth of a new paradigm in the use of computer technology within reading instruction. Originating as a research and development collaboration between public schools, universities, various research agencies and Apple Computer in 1985, it began at a “time when promises and excitement about the potential of technology to enhance the learning process abounded” (Sandholtz et al, 1997, p. 3) and was seen as a potential ‘magic wand’ for America’s struggling educational system. ACOT wanted to investigate how both teachers’ and students’ uses of computer technology could potentially affect both teaching and learning. Toward that end, ACOT worked in collaboration with educators as they operated within the following goals: the installation and operation of computer-saturated classrooms as living laboratories within K-12 classrooms, the integration of state of the art technologies within the instructional fabric
of schooling, bringing about positive educational development and change and studying and understanding the impact of total computer access on students, teachers and instructional processes (Sandholtz et al, 1997).

As the classrooms moved toward these goals, Sandholtz and her colleagues (1997) noted five stages of instructional evolution experienced by teachers with whom they worked. At Entry stage, teachers moved from a didactic text-based traditional curriculum and instructional mode into the world of computer technology within the classroom. In the Adoption stage, the researchers noted that teachers began to use the electronic technology in support of text-based drill and practice instruction. As discussed earlier, though computers were being used, they were simply a reification of a different technology to maintain a similar instructional stance and philosophy that remained didactic and teacher centered in nature. As teachers progressed to the Adaptation stage, the researchers saw the computer technology becoming thoroughly integrated into their traditional practice. Though students were still engaged primarily in lecture, recitation and seat work, they now used word processors, databases, graphics packages and computer assisted instruction for approximately one half of their school day. Student productivity increased and students scored significantly higher on standardized tests of language arts and math skills. In the Appropriation stage, teacher attitudes toward technology took a significant shift. They not only understood the technology but also used it easily as a tool to accomplish their tasks. Old habits were replaced by new which opened the doors for the teachers to see the usefulness of technology and to explore better and more imaginative uses of this technology within their classrooms. Appropriation was
“the end of efforts simply to computerize their traditional practice” (Sandholtz et al, 1997, p. 43). During the Invention stage, teachers explored new patterns of instruction and new relationships with students and other teachers. Their instructional practice became constructivist in nature with interdisciplinary projects, team teaching and individually paced instruction standard classroom practice and procedure. They “became more disposed to view learning as an active, creative and socially interactive process...knowledge came to be viewed more as something that children must construct for themselves and less as something that can be transferred intact” (Sandholtz et al, 1997, p. 47).

ACOT’s experiences in constructivist approaches to computer technology was, for the most part, isolated at this time. In 1989, Balajthy continued to report that “the major trend in the use of computers in reading education . . . [was] . . . the use of microcomputer software as a supplement to the traditional classroom curriculum” (p. 35). Though still basically a didactic teacher centered approach, these software packages provided invaluable assistance in diagnosis and prescription processes. Teachers began to use computers more as tools of instruction, and the human teacher in the role of an essential interface, though not yet a co-learner, between child and computer, providing both feedback and the facilitation of reading instruction, became a foundational concept. (Balajthy, 1989; Reinking & Bridwell-Bowles, 1991).

**Into the 1990s and Beyond**

The National Reading Panel Report (2000) looked at only empirical studies of computer technology and reading instruction conducted from 1986 through 1996.
Though finding a dearth of research that looked at the use of computer technology within reading instruction, in spite of this, they did find promising implications and applications within some studies. They found that computer technology continued to be successful today, as in the past, as an additional instructional support within the traditional reading curriculum. Multimedia computer software, such as CD-ROM storybooks, among others, has proven to be successful for students who need an additional support within the traditional reading curriculum. The combination of speech and interactive capabilities with the on-screen text had potential to facilitate reading instruction for students with particular learning styles and modalities. Hypertext, in its student-controlled capabilities for approaching only particular sections of text at particular times held potential to assist readers having difficulties with specific reading passages. Teachers began to use hypertext within reading instruction with positive results.

The ascent of new types of interactive storybooks, or e-readers/e-books, in the new millennium have brought with them an additional toolbox with positive potential for supporting emergent literacy instruction. Buckleitner (2011) discusses the advent of some of these additional capabilities within the context of software designers’ use of the ‘Eight Pillars of IPad’; all of which can enrich the ‘story-based experience’ for the user. These Eight Pillars include: a large multi-touch screen with enhanced abilities to use multiple digits in directing story flow and activity and the screen’s ability to detect depth of pressure and direction of movement; a motion detection capability which allows control of screen/story events through tilting or shaking the device; enhancement for the ears with a focus on the IPad’s microphone and its capability to capture story narrations;
enhancements for the eyes focuses on the inclusion of multi-purpose cameras for the capture of barcodes, QR codes, pictures and even for augmenting reality; enhancements for the voice through magnification via stereo speakers; an anthropomorphic heart as exemplified through battery power and a large internal memory function; free, fast and intelligent internet access and, last but certainly not least, content provided through thousands of apps that are both inexpensive as well as maximizing the capabilities of previous iterations of interactive media such as CD-ROM storybooks, e-books, e-readers and more (p. 8). Larson (2010) notes that “e-books in general, and digital readers in particular, have the potential to unveil an array of new teaching and learning possibilities as traditional and new literacy skills are integrated in meaningful ways” (p. 21).

Research continues to consistently show the importance, though, of teacher as scaffold in the use of the newer computer technology applications (Reinking & Bridwell-Bowles, 1991; National Reading Panel, 2000; Zucker, Moody & McKenna, 2008). This scaffolding becomes ever more urgent in the necessity to help children make the connection and see the relevance between what they experience in their high-tech world in terms of literacy with that which they experience within their classrooms. Larson (2010) issues the call that with the “rapidly changing nature of e-books and digital reading devices, (this) demands a progressive research agenda that examines the use of new technologies in authentic school settings…although print books are the world’s oldest means of communication and the Internet one of the newest, digital readers merge the two media in innovative and interesting ways” (p. 22). Above all, as we move forward, the future will provide us with the skills to “better tap the potential of this
technology for the benefit of children . . . (and) if used wisely with an old fashioned good story, there’s an excellent chance for a happy ending” (Buckleitner, 2011, p. 10).

Discussion of Findings and Implications for Current Study

With all of the progress made, Reinking and Bridwell-Bowles (1991) report that in data gathered over a ten-year period beginning in the early 1980s, computer-based activities were still not considered integral parts of reading instruction programs. Today, as in the past, it appears that though there can be difficulties in the integration of computers within language arts instruction, skillful teachers will be able to overcome them. The key is for teachers to envision the computer as an integral instructional tool within their reading course of study and their personal instructional styles. Miller and Burnett (1987) see that “many of the controversies surrounding the use of microcomputers in education are similar to those debated currently in the area of language arts such as whether reading should be taught as a series of subskills, with an initial emphasis on decoding, or fostered as a holistic process, with an early and continuing focus on meaning” (p. 178). Whether teachers take a subskill approach or a more holistic perspective, if particular software packages are compatible and useful within a teacher’s instructional stance, they can be used as a component of instruction. When this congruence does not occur, the teacher is free to use other methods of available instruction. Computer software programs that provide integrative responses to text are used to follow classroom instruction and practice. Even so, most contemporary research focuses on teachers integrating specific Computer Assisted Instruction (CAI) programs within their reading instruction, ones that offer support for sub-skills such as
phonological awareness, word identification and fluent text reading (Blok et al, 2002).

Current research on the use of eStorybooks in early childhood classrooms is making very slow progress yet there are multiple and ongoing calls for engagement in practice (Bus et al, 2009; Evans et al, 2009; Labbo, 2009; Larson, 2010; McKenna & Zucker, 2009; Neuman, 2009; Shamir & Korat, 2009; van den Broek et al, 2009). The studies cited here are but a few points of beginning.

This dichotomy/debate is very much the same as that between didactic and constructivist teaching styles and philosophies. The didactic, traditional approach, is rooted heavily in the teacher as the center/prescriber of knowledge. As computer technology enters within this traditional framework, the computer technology has the potential to act in the place of the teacher, to be a tool of knowledge prescription rather than a facilitator of joint knowledge construction. Product, as opposed to process, is of central import with computer prescribed tests and a very process-product paradigm.

Even the original genesis of the computer technology research in the 1960s and 1970s was empirically driven and rooted in positivism and determinism. ACOT’s constructivist process used a child-centered pedagogy where students and teachers co-construct meaning. Rather than the computer technology acting in the place of the teacher, the computer needs to be seen as a tool, a scaffold, a facilitator in assisting and empowering students as learners (Bus et al, 2009; Neuman, 2009; McKenna & Zucker, 2009; van den Broek et al, 2009). This constructivist process is embodied in some of the newer classroom software (Roskos & Brueck, 2009). Interactive text which enables students to manipulate story events is used in integrated language arts instruction as a reading and
writing tool (Bus et al, 2009; Neuman, 2009). Simulation programs provide contexts and content as normal parts of language arts instruction. These programs are also used to integrate language arts into content teaching. Reinking and Bridwell-Bowles (1991) see that

the open-ended capabilities of the computer to monitor an individual’s performance, to provide individual assistance, and to stimulate active processing of written language suggest that the computer will remain an important tool that significantly expands options for teaching reading . . . the increasing availability of computerized speech suggests interesting new possibilities for teaching sound-symbol correspondences as well as helping beginning readers decode words during independent reading. (p. 333)

Sandholtz et al’s (1997) involvement with the ACOT process taught one to be slow and circumspect when it came to evaluating teacher change and classroom technology use. Their longitudinal process enabled the ACOT researchers to examine teacher experiences with and uses of technology within reading instruction over a number of years. This enabled and equipped a long-term perspective missing from much of the research that focused on integrating computer technology within classroom processes. This gathered wisdom and realistic gaze provides a fitting conclusion to this look back at the use of computers within classroom reading instruction, but also a hopeful look forward.

Technology is not a panacea for educational reform, but it can be a significant catalyst for change. To those looking for a simple innovative solution, technology is not the answer. To those looking for a powerful tool to support collaborative
learning environments, technology holds tremendous potential. (Sandholtz et al, 1997, p. 184)

**Overview of Research with Electronic CD-ROM Storybooks**

The varied capabilities of CD-ROM storybooks offer enhanced possibilities for literacy instruction. McKenna (1998) states that:

Talking books – electronic books equipped with digitized pronunciations of words and oral renderings of larger textual units – have the potential to remove the decoding bottleneck facing beginning readers. By accessing pronunciations of words that are unfamiliar in print, beginning readers should be able to negotiate text at or near their listening comprehension level (p. 46)

Perhaps the most significant contribution of electronic text to reading instruction is the amount of learner control provided. When readers come to a word they don’t know, a simple mouse “click” on the word will give them the pronunciation. Reading and interacting with a book on a computer screen has the potential to be a powerful motivating force for even the most reluctant readers (Matthew, 1996). Some studies also indicate that electronic text in CD ROM format has the potential to even increase reading comprehension (Miller, Blackstock and Miller, 1994).

As mentioned previously, CD-ROM storybooks enable children to construct meaning from a text enlivened by animation, sound and graphics. Text is highlighted as it is verbalized and helps the children to track the words visually from left to right and top to bottom as they’re read. “Because beginning readers customarily read aloud . . . voice recognition as a means of monitoring (pronunciation) seems a natural adjunct to talking
books as software becomes more sophisticated and hardware becomes more powerful” (McKenna, 1998, p. 52). CD-ROM storybooks can play an integral role in facilitating language learning when utilized as one of many reading instruction strategies. Not only can CD-ROM storybooks provide an early listening and reading experience that can assist children in developing both the skills and interest that can make them lifelong readers, but these multimedia storybooks can also be sensitive and responsive to children who may learn differently as will be investigated later within this review.

As we move forward, in an attempt to respect the original research texts, throughout these discussions will be found a variety of descriptors in lieu of CD-ROM storybooks – terms such as online storybooks, eStorybooks, eReaders, electronic storybooks – all of these can be considered as equivalent references for the purpose of this text and ensuing discussions.

**Reader Response Theory and Electronic Texts**

If we look at the nature of response-based literature classrooms and the elements involved in facilitating and encouraging children’s response to literature, we find that much of the software that is currently available for elementary school age students is ineffective. Swan and Meskill’s (1996) Multimedia and Literature Teaching and Learning Project’s research evaluated multimedia literature products from a response-based perspective and found that “hypermedia literature applications currently commercially available, although technologically quite good and perhaps supportive of text-based pedagogies, are not inherently supportive of response-based literature teaching and learning” (p. 167). Swan & Meskill’s (1996) research team developed a list of
eleven desired software features that would facilitate and enhance reader-response learning and teaching. These included transparent navigation, intertextuality and juxtaposition, facility to share responses, facility to support non-text responses, facility to make links, support for envisionment, access to multiple perspectives, support for dialogue, promotion of student ownership (which involves a provision for student entry into textual worlds), presentation of background knowledge and facility to explore the author’s craft. (Meskill and Swan, 1998). Products that received higher ratings were ones that “provided multiple voices…and interactive pages on which students could click on various objects to find hidden animations. Evaluators who observed students using the latter commented that these pages encouraged an exploratory approach to literature and elicited both questions and links to personal experience from their users” (Swan and Meskill, 1996, p. 182).

As we’ll see later, the presence of interactive animations within CD-ROM storybooks provide for a variety of responses from different researchers, many of whom see their presence as detractors from a focus on story content and recall. In Swan and Meskill’s (1996, 1998) qualitatively based group research with 100 first through fifth graders over a two and one half month period, these interactive capabilities were demonstrated to have positive influences on a child’s response to and connection with story. Another interesting finding was that a child’s connections with the interactive storybooks often increased motivation for connecting with the print versions of the storybooks and making comparisons with its CD-ROM counterpart. Bridge building was taking place in that multiple literacies were complementing each other and extending the
literature experience beyond the digital screen to the print book.

Reader-response theory was further investigated in the mixed-methods work of Chu (1995) in which she looked at three first graders’ literary responses to CD-ROM storybooks over a five-day period. Videotaped sessions recorded both the verbal and nonverbal responses of the children while reading and these data supported alternative data gained during group discussions where the children were encouraged to freely respond to the electronic storybooks they had read. Chu (1995) found that the children’s interactions with and response to the CD-ROM storybooks fell in line with Louise Rosenblatt’s (1978) definition of aesthetic reading in both their desire for repeated interactions with the storybooks and their desire for written and illustrative retellings and discussion of such. In making connections between the various CD-ROM storybooks they read during their discussions, the children also demonstrated their ability to make intertextual connections with their creation of relationships between the stories and their ability to identify differences and similarities between main characters and plots. In short, the children were actively involved in their electronic environments and in control of their learning choices with the CD-ROM storybooks.

In another instance of looking at children interacting with CD-ROM storybooks, James’ (1999) qualitative study observed four children, ages four, six, nine and fourteen, reading two online texts in her home over an indefinite period of time. Her purpose was to look at how the differing multimedia elements present in CD-ROM storybooks can “shape the reader’s experience of the text” (p. 47) and how the “tension between the linear . . . and the interactive mode…allows the reader to view a story from multiple
perspectives” (p. 47). Each of the CD-ROM storybooks used different multimedia elements. One remained a basic linear text and traditional narrative with its multimedia encouraging the reader to experience the story through the main character. The other’s interactivity and multilinear textual nature pushed the boundaries of what one considers a traditional narrative and allowed the reader to “drive the story”, exploring its multiple pathways, without sacrificing the storyline at hand. Though strikingly different CD-ROM story packages, each provided several opportunities for reader participation and interaction and for readers to become co-tellers of the tales. Similar to Chu’s (1995) findings, James also found that CD-ROM storybooks, by virtue of their interactivity and design, encourage active reader response from their participants.

**Engagement with Electronic Text**

Children may be able to read and interact with children’s literature in electronic formats, but how engaged are they with the content at hand? Bangert-Drowns and Pyke (2001) drew upon the literary response theories of Louise Rosenblatt, J.A. Langer and others to define what they considered to be “literate thinking,” an employment of higher level thought processes that facilitate evaluation and interpretation of text as well as an employment of multiple perspectives in both response to text and in making personal connections with and applications to the text. They hypothesized that literate thinking and engagement of text would go hand in hand, with their definition of engagement as “the mobilization of cognitive, affective and motivational strategies for interpretive transactions with text” (p. 215).
Toward this goal and through their observation of students in Pre-K through the 6th grade, the researchers were able to construct a taxonomy of student engagement with educational software. This taxonomy was comprised of seven levels; literate thinking, critical engagement, self-regulated interest, structure dependent engagement, frustrated engagement, unsystematic engagement and disengagement. Though literate thinking was not consistently observed and determined in this study, what was most intriguing was the experience of a fifth grade student who was in fact involved in literate thinking with the software. The CD-ROM storybook with which she made multiple text-to-life connections was *Arthur’s Teacher Trouble* (Random House-Broderbund, 1994). Interestingly enough, this is the same software title with which Labbo and Kuhn (2000) had problems when it was used with a Kindergarten student. A more detailed discussion of their research will come later, but this differing experience hints at the consideration that software design of CD-ROM storybooks and the developmental and cognitive appropriateness of such should be a strong consideration when choosing titles to use with children. In addition, it opens the door to consideration that learning styles and differing intelligence strengths affect response to story in varying formats and these learning differences should be taken into account when decisions are made concerning the use of CD-ROM storybooks within the reading instructional strategies employed within the classroom.

Bangert-Drowns and Pyke (2001) conceded that “perhaps literate thinking is more common among older students or with narrative software” (p. 226). Levels of engagement with electronic text could be related to a student’s disconnect with the
software. This disconnect could be present for a variety of reasons such as student disinterest, developmental and/or cognitive inappropriateness or even lack of skills in navigating a particular software package. As we look at additional studies of children interacting with and responding to children’s literature in electronic formats, these are issues and concerns that will rise repeatedly in a very complex and often indeterminate body of research. We are only skimming the surface in regards to the complexities involved when children and electronic text connect and this remains an area rife for potential research.

Multiple Formats/Multiple Literacies

Miller, Blackstock and Miller (1994) conducted an early case study that looked at storybooks in both print and electronic formats. One of the seminal pieces of research in this area, their focus was on reading improvement that could result from children’s use of CD-ROM storybooks and how that compared with improvements gained through the use of the print storybook counterparts. Four third grade students participated in repeated readings of the print and CD-ROM storybooks both with and without teacher intervention. Computer printouts provided feedback on the words for which the students requested online help in pronunciation and definitions. Observation provided information on the reading strategies that students employed while reading the CD-ROM storybooks. Electronic storybook sessions were videotaped and print sessions were audiotaped.

Analysis of results showed that students’ reading skills improved with both the print and electronic storybooks, but there were greater gains evident with the CD-ROM storybooks. These gains were measured via “search for meaning” miscues and their
decrease over the repeated readings. The researchers hypothesized that this greater gain was attributed to the online availability of help with both pronunciations and definitions of words. Based on individual student observations during the course of the research, they strongly recommended that optimal use of and results with CD-ROM storybooks within the reading curriculum will occur only when teachers participate in the process and at least occasionally monitor the child’s online reading to determine traits observed as well as strategies for future instruction based on the child’s individual needs.

At this point, it becomes evident that CD-ROM storybooks can be important partners in reading instruction, but still require the skill and direction of teachers to maximize their effectiveness, whatever the age of the child. When CD-ROM storybooks are used in isolation without this benefit, then potential gains will be minimized. As Medwell (1996) states, “Computers are not going to take over the teaching of reading and cannot replace the diagnostic and remedial flexibility of a teacher reading with a young child, but they may be another way to offer beginning readers some useful extra support” (p. 46).

One example of an interesting foray into experimentation with children’s literature in multiple formats is that of Smith’s (2001) work with her preschool son over the period of a year. In a search for multiple storybook literacy, Smith’s case study involved sharing children’s literature with her son in traditional print storybook format, language experience approach storybooks and CD-ROM storybooks. Her theoretical framework was one grounded in the works of Vygotsky (1934/1986, 1978) and Bakhtin (1986). She equated the storybooks and associated paraphernalia in their various formats
as artifacts/tools that facilitated exploration. Her son’s positive connection with and response to CD-ROM storybooks was affected by an emphasis on and with technological artifacts and the illustrative and textual hotlinks associated with hypertext environments.

Smith (2001) concluded that “story became something that he read, created and did” (p. 176). His experiences with and reactions to the hypertext environment and artifacts was quite similar to older students’ reactions to and preoccupation with illustrative hotlinks, which in some cases, can either be interpreted to the exclusion of story understanding and comprehension or as found in Swan and Meskill (1996), a positive tool to encourage exploration of literature. Literacy and technology are intertwined and must be recognized as such because “the impact of technology on today’s youth and the way they are incorporating and internalizing it into their understandings of the world necessitate the inclusion of technology in literacy research” (Smith, 2001, p. 177).

Fisch et al (2002) recorded a different kind of parent-child interaction reading online storybooks in their work with seven parent/child dyads over a week’s time frame. The research focused on behaviors and discussions that occurred during these joint readings and how they compared with those same interactions during shared readings of print storybooks and television viewing. A question of particular interest focused on whether discussions were purely connected to the online material or whether there were text-to-life and life-to-text interactions where life events and experiences were related to story occurrences, indicating a deeper and more metacognitive process at work.
This qualitative study found that “online storybooks can promote many of the same kinds of positive behaviors that have been observed in joint reading of traditional books and that have been shown to be related to later performances in literacy” (p. 444). Fisch et al. (2002) showed that the same kinds of meaningful interactions about text can occur within electronic environments as questioning strategies and interactions help the child communicate with text and story in similar ways.

The researchers used an interesting coding scheme to record parent and child behavior while sharing the online storybooks, one similar to that used in prior research that combined reading traditional print storybooks and viewing television programming. This coding scheme deserves further evaluation to determine its effectiveness and applicability in future research. Though results were encouraging, Fisch et al. (2002) agree that their results should be interpreted with caution due to the small sample size (seven parent-child families) and also because their comparison of the online storybook reading experiences are compared to traditional storybook readings from past research, not those shared by the same families within their research.

Repeated readings of storybooks can often have a positive effect on a child’s comprehension and understanding of story simply through the repetition and confidence gained through the multiple readings. In their three week study, DeJong and Bus (2002) looked at how repeated readings of both print and electronic storybooks influenced what 48 Kindergartners internalized from the story readings and how, if at all, the format of the story affected these internalizations. Children were exposed to the print storybooks, the full electronic storybook, the electronic storybook w/o games or both the print and
electronic storybooks together. Though utilizing a modified pretest/posttest control group design, qualitative measures employed within the methodology effected more of a mixed-methods approach.

The CD-ROM storybook chosen for use within this study, *Arthur’s Teacher Trouble* (Random House-Broderbund, 1994), was the same Labbo and Kuhn (2000) found to be an example of inconsiderate text, with multimedia interactions sometimes incongruent with story content and understanding. That said, the researchers found that “when games were accessible . . . all of the children played games about half of the time at the expense of reading the text. Games distract children’s attention from other options” (p. 153). They concluded that the electronic format was not as efficient as the print in supporting story internalization. Multimedia interactive features acted to divert the children from multiple readings of text in favor of random exploration of the interactive capabilities.

The inconsiderate electronic text used in this study contained text and multimedia features that were not consistently mutually supportive. Also, lack of adult intervention and scaffolding left the Kindergartners alone to navigate the multimedia text as they saw fit. Perhaps the age, lack of scaffolding and the selection of electronic text worked together (or didn’t!) to thwart the potential benefits of the electronic text to these emergent readers. An important, though probably obvious, element here is the necessity for a skilled adult facilitator to work with children in the literacies of navigating electronic text and how to make the most cognitively of this experience.
Story Recall/Comprehension and Electronic Text

The interesting concept of considerate and inconsiderate text is raised within a single case study conducted by Labbo and Kuhn (2000). The researchers looked at the relationship of the CD-ROM storybook animation features to the story itself. They focused on research that claimed that “how an author or illustrator presents thoughts, feelings and values in the narrative and illustrations affects children’s abilities to make inferences” (p. 191). The researchers used the construct of “considerate text” (Armbruster & Anderson 1981, 1984 cited in Labbo & Kuhn 2000) as a central investigative thought to explore whether CD-ROM storybooks are considerate texts that facilitate children’s understanding and story recall or inconsiderate in their lack of help to young readers. Lack of help here is defined as the absence of supportive congruent structures within the text, illustrations and interactive features that assist the child with story comprehension and understanding. A content analysis of the CD-ROM storybooks was conducted to ascertain whether the storybooks could be perceived to be either considerate or inconsiderate texts. The determining factor was whether multimedia features related to story structure or not, with those sharing a relationship considered to be considerate texts.

Their Kindergarten participant was chosen from a classroom within which they conducted a larger ethnographic study that looked at students’ literacy development in relationship to technology over the course of a school year. The child was observed using two CD-ROM storybooks, *Stellaluna* (Random House-Broderbund, 1996) and *Arthur’s Teacher Trouble* (Random House-Broderbund, 1994), the first deemed to be
considerate and the second, inconsiderate text. His interactions with the story were analyzed using Wittrock’s Generative Learning Model, one they deemed “useful for considering a child’s learning in electronic environments, because it focuses on a reader’s attention, motivation, knowledge processes and generative learning” (p. 198). Within this Learning Model, the construct of “attention” related to what was attended to on screen, “motivation” considered why he attended to particular features, “knowledge” to his meaning-making processes and “generation” to how his retelling of the story would reflect his story comprehension. The resulting analysis showed that the considerate text which had media features congruent to the story, resulted in cognitive meaning making processes such as making predictions, strategically planning, making inferences about character’s motives, summarizing events and making connections with his own life experiences. This suggests…that his comprehension of the story was being enriched and supported by media effects that were integral and logically related to the story. (p. 204-05).

Their participant’s experience with “inconsiderate text” resulted in what the researcher’s termed “passive cognitive mode.” He had difficulty with story retelling and focused on the more incongruent features of the multimedia animation that lacked cohesion to the story. The findings of Labbo and Kuhn (2000) stress the importance of well designed software with multimedia features that enhance rather than detract from story cohesion and content. This cohesion will help CD-ROM storybooks to act as scaffolds in a child’s literacy development.
The concept of considerate and inconsiderate texts was raised only in Labbo and Kuhn’s (2000) study. This is a useful and logical theory that appears to assist in the interpretation of often very different results in the research surrounding CD-ROM storybooks and their usefulness in assisting young children in their literacy development. It also raises interesting questions concerning response and how it can be affected by how well the illustrative content and its interactive capabilities combine with the on-screen text and act as a unified source of information. In addition, it highlights questions about the developmental and cognitive appropriateness of specific electronic texts and how using them with different ages can produce markedly different results. Consider the fifth grader in Bangert-Drowns and Pyke’s (2001) study whose literate thinking, the highest level of engagement with software in their taxonomy, was most evident in the text deemed inconsiderate and unsuccessful within Labbo and Kuhn’s (2000) research.

Similar CD-ROM storybooks and their collaborative use by pairs of 62 eight-year-old children frame the mixed-methods study of Underwood and Underwood (1998). In a parallel of sorts to the work of Labbo and Kuhn (2000), these researchers were also interested in the connection between the multimedia animations and how they relate to story understanding and comprehension. In addition, they looked at possible gender differences when interacting with the CD-ROM storybooks, what it was on-screen that captured the students’ attention and what of these features were remembered one month later when they would be asked to recreate a story based on the main character. The Underwoods used the same storybook, Arthur’s Teacher Trouble (Random
House-Broderbund, 1994), that Labbo and Kuhn (2000) found to be an example of inconsiderate text.

Though the children interacted predominantly with the multimedia animations during their time with the CD-ROM storybook, these interactions did not figure prominently in their story retellings a month later. Their retellings focused on more complex story events rather than on entertaining, though incidental, aspects of the CD-ROM story. And gender was shown to have had minimal effects. Their somewhat different results may again indicate that older children (eight years of age versus five years of age) may be able to enjoy the multimedia animations without becoming distracted from their ultimate goal of story understanding and comprehension.

In their mixed-methods study, Trushell, Burrell and Maitland (2001) looked at small groups of 60 fifth graders interacting with a CD-ROM storybook over a six-week time period to determine the effect their style of movement through the story, whether a linear or nonlinear one, would have upon their story recall. The researchers refer to interactive components of the story as “eye-candy” and make distinctions between those interactions considered supplemental or incidental to the story at hand. Their description of incidental “eye-candy” seems to correspond to the discussion of inconsiderate texts by Labbo and Kuhn (2000) while the supplemental “eye-candy” corresponds to that of considerate text where interactivity supports and extends the storyline rather than detracting or diverting from such.

Throughout the students’ story movements, students chose incidental “eye-candy” in a 4:1 ratio over that considered supplemental. Students’ story recall measured both
verbally and by multiple choice questions, was poor and researchers considered the lack of teacher intervention in guiding and influencing students’ more linear progression through the text as well as moderating their choices of the incidental “eye-candy” to be determining factors.

Part of the problem here also seems to rest with the choice of the CD-ROM storybook used with the students and its embodiment of what appears, by the researchers’ description, to be an inconsiderate textual design. CD-ROM storybook designers need to be cognizant of both the merits and pitfalls of interactive elements within their software and strive to create designs with interactive features that supplement the storyline, as a result helping to facilitate students’ story recall. Researchers need to be aware of these considerations as well within their study designs.

Do these interactive storybooks have the potential to support or disrupt learning? The answer does not appear to be clear cut and holds many conditions. CD-ROM storybooks provide the opportunity for children not only to interact with story and illustrative content but also to make personal and individual decisions about their own exploration of story and all that it holds. This story exploration is a positive element of reader-response learning (Swan & Meskill, 1996). But how does varying means of story exploration affect story recall?

In an attempt to answer this question, in their experimental posttest control group study, Ricci and Beal (2002) were interested in whether the interactivity present in CD-ROM storybooks influenced a child’s story memory. Over an indeterminate length of time, they worked with 66 first graders who had varying access to the elements of both
a CD-ROM storybook and the story in a non-interactive audiovisual format. Some had full access to both the visual and interactive capabilities, some only to the audio, some to non-interactive audiovisual presentations and some to the CD-ROM storybook but without benefit of controlling the on-screen interaction with multimedia elements. After asking children a series of questions to encourage story recall, researchers found that a combination of visual and audio elements aided children’s story memory, whether interactive or not, but equally they found that interaction with the multimedia elements did not impede the child’s memory. Again, we return to the thought of well-designed children’s interactive media and the importance of the design being such that the interaction inherent within the content is one that will facilitate a child’s learning when using the product.

This study utilized a research design that should prove useful in future studies. Techniques such as videotaping children’s interactions with the CD-ROM storybook and their subsequent coding would prove very helpful in documenting a child’s specific use and interactions. Not only is there an awareness of the screen and what’s happening there, but it’s also possible to see the child’s body language and affect when taped from both the front and the rear of the child. Though these activities were documented visually, this was done externally through means of observation. In future software designs, one would hope that the child’s interactions with the CD-ROM storybook in terms of frequency and location of mouse clicks, could also be gauged somehow through the administrative functions and features of the software.
Individual Differences and Electronic Text

Matthew (1997) sees electronic books possessing a “mixture of visual, tactile and listening modalities . . . (that) . . . enables students to learn through their preferred modality” (p. 263). Similar to Miller et al (1994), in a parallel study, Matthew’s (1996) pretest/posttest control group experimental research conducted with 74 third graders over four weeks explored how reading comprehension was affected when children read various combinations of print and CD-ROM storybooks. Some read traditional print only, some electronic and others read the print and electronic in consort.

The differences lay in how reading comprehension was measured. Matthew used a combination of alternative assessments which used both open-ended questions as well as story retellings. Story retellings showed that children who read the electronic texts scored significantly higher than those reading the print storybooks. This could be attributed to the fact that “CD-ROM storybooks provide a multi-sensory learning experience that enables students to literally interact with the text and the illustrations and to actively process the text, both of which lead to a personal understanding of text” (Matthew, 1996, p. 267). When the students read both the electronic and print storybooks, their reading comprehension soared even higher.

Matthew (1997) determined that “using both electronic and print texts as complements to each other facilitates the different learning styles found in classrooms” (p. 272). She also saw the need for teacher support and intervention in assuring that students are reading electronic text successfully and not being unduly distracted by the fun and attractive multimedia animations that run prolifically through the story text. Matthew’s

**Discussion of Findings and Implications for Current Study**

As mentioned previously, reading experts (Adams, 1986 cited in Chu, 1995; Balajthy, 1988 cited in Chu, 1995; Matthew, 1996; McKenna, 1998; Miller, Blackstock & Miller, 1994) are arguing that technology is particularly critical for an increasing percentage of our population who don’t respond well to traditional print media and who are reluctant readers. Additional research is needed to investigate how children respond to and benefit from literature in electronic formats within the lens of multiple intelligence theory and studies of differing learning styles and modalities. As we consider the learners in our classrooms and the different learning styles, preferences, modalities and intelligences they represent, the important question is to assure, within our capabilities, that they have access to literature in various formats to facilitate and assist them as they become multiply literate.

As the research has demonstrated, developmentally and cognitively appropriate CD-ROM storybooks used within teacher-guided environments have the potential to facilitate multiple literacy development. As Kinzer and Leu (1997) state:

> We live during a time when fundamental change is taking place in the nature of literacy and learning as digital multimedia resources enter our world. Literacy and learning are being redefined by the digital communication and multimedia technologies that are quickly becoming a part of the information age in which we live. . . . We believe these new tools will increase not decrease the teacher’s
central role in orchestrating learning experiences. We will be challenged to thoughtfully guide students’ learning within electronic information environments that are more complexly networked than traditional print media and presenting potentially richer and more integrated learning opportunities for both teachers and students. (p. 126)

These electronic information environments call for a new consideration of the representation of story and demonstrate how a look into the research surrounding semiotics, dual-coding theory and the concepts of multiple literacies can lend credence to the crucial role that electronic CD-ROM storybooks can play in the lives of children who receive and interpret story in differentiated ways.

**Overview of Research on Multiplicities: Multiple Sign Systems, Multiple Literacies and Multimodal Learning**

**Semiotics**

How can the ideas behind multiple sign systems (Harste, Short & Burke, 1995 cited in Berghoff, 1998) and concepts derived from the discipline of semiotics support children in their literacy development? We are routinely familiar with various sign systems but may not think of them in separate and distinct communicative terms. Areas such as art, music and math and various combinations of such are, in fact, systems of communication that can be used in a variety of ways for meaning-making purposes. Berghoff (1998) sees each of these areas resembling language in their capabilities to represent communication in various ways. She celebrates the abilities they give us “to know and express what we know in multiple ways” (Berghoff, 1998, p. 520). This
concept of multiple sign systems originates in the study of semiotics. Labbo (1996) finds a comfortable definition for semiotics as “the study of signs (i.e. Meanings) and sign systems, [and] involves the analysis of how individuals within particular cultural contexts produce meaningful symbols, use symbols to communicate, interpret symbols and systematically organize symbols into codes of meaning” (Labbo citing Eco, 1990; Gillan, 1982). Possible signs or symbols that could be perceived to be used by children within classroom contexts could include those of oral language, print, icons, pictures and music, among others. These are all symbols used within CD-ROM storybooks to represent story in a multimedia fashion.

As one considers literacy and reading within these constructs, it behooves us to think of reading in a “big picture” way. Rather than considering reading in exclusive terms of a print-based literacy, one needs to look at reading much more expansively and inclusively, as occurring within any meaning-making process and within any kind of sign system text. Berghoff (1998) considers that

Thinking of ‘reading’ as a process that cuts across sign systems is parallel in many ways to the manner in which authoring is changing. Technological developments now allow us to create texts in visual images, sound bites, music, video clips and animation, as well as the written word. To survive in this complexity, learners have to have control of the cognitive processes that cut across sign systems – the processes that . . . have (been) valued in language arts – reading, authoring, inquiry – need to be developed as the ability to work flexibly across all sign systems. (p. 522)
Electronic CD-ROM storybooks effectively cut across sign systems in their multimedia presentation of story. Many readers do not thrive in an exclusively print-based literacy environment for a variety of reasons. For some children, their intelligence strengths are ones that thrive in an environment similar to the one Berghoff (1998) describes rather than within the reality of their classroom experience. Their ability, in fact their potential need, to traverse across these multiple sign systems can be facilitated by experiencing story via interactive CD-ROM storybooks.

In Baker’s (2000) qualitative study as a participant observer with 26 fourth graders, she examined literacy within a sociocultural and semiotic lens. Within this self-described technology-based classroom, Baker found that students operating in both visual and auditory modalities used multiple sign systems in consort and interchangeably within their construction of various literacy activities. Students used text, graphics, animations, video and audio to represent content within the various activities. Baker concluded that theories of semiotics, multiple sign systems and modalities help us examine not only young children’s literacy development, but also older children’s literacy development. One implication from this study is that elementary teachers may need to cease isolating literacy into separate content areas . . . because this is not representative of how our society thinks and reasons in our increasingly technological environment. A second implication is that technology may provide a bridge between literacy which occurs in our society and literacy education which needs to occur in our schools. (p. 107)
Baker is very astute in her recognition that there is often a chasm between how literacy is experienced in society at large and how it is experienced and practiced within our schools. In addition, she has wisely highlighted and recognized that there is that distinct separation and beatification of print literacy as a primary means for both delivering and receiving informational content or story transmission. This primacy of print literacy has often been extolled to the exclusion of other more unique paths to literacy that include those electronic. (Neuman, 2009).

Multiple Literacies

In looking at this chasm between literacy as experienced in society and that within the classroom, citing the work of Baker (2000) in addition to that of Reinking (1995) and Labbo (1996), Kinzer and Leu (1997) recognize, as well, that “we are entering a period where traditional definitions of literacy will need to be evaluated for their appropriateness within electronic environments” (p. 134). This recognition involves the consideration of the many new electronic tools of learning at our disposal and the need to incorporate these within classroom literacy environments and activities. In another piece, Leu (2000) discusses further the concept of literacy as one of technological deixis. He adopts the term deixis from linguistic studies where it signifies the nature of words such as now, here, today, etc and their dependence upon their temporal nature for a specific contextual definition. He sees literacy as deictic in that “both the forms and functions of literacy have regularly changed over time. This will continue into the future at a much faster pace…The changing constructions of literacy within new technologies will require us to prepare children to keep up with these changes” (p. 117). He cites Bruce (1997) who
sees a transactional relationship between literacy and technology: as one changes, so does the other. As we explore the uses of technologies within our classrooms, their very use changes the nature of the literacies with which we work. Leu (2000) sees these “transformations of literacy because of new technologies and envisionments of new forms of technology are the primary sources for the increasingly deictic nature of literacy” (p. 118). Within these changes lies the promise of ever more constructivist classrooms as the “technologies of literacy simply will change too quickly and be too extensive to permit any single person to be literate in them all…This will distribute knowledge about literacy throughout the classroom…” (p. 121). Both teacher and student will facilitate the literacies of each other within these collaborative environments.

Gee’s (2003) look at video games and their connection to literacy and learning is an interesting and additional foray into the exploration of the parallels found and recognized between children’s real world experiences with literacies and those literacy experiences of the classroom. He sees playing video games as one of many literacies; “once we see this multiplicity of literacy (literacies), we realize that when we think about reading and writing, we have to think beyond print” (p. 14). The video games he studies are self-described examples of “multimodal texts (texts that mix words and images) . . . images often communicate different things from the words. And the combination of the two modes communicates things that neither of the modes does separately” (p. 14). Gee (2003) also views thinking of literacy as primarily a print-based domain as faulty and advocates the consideration of semiotic domains.
If we think first in terms of semiotic domains and not in terms of reading and writing as traditionally conceived, we can say that people are (or are not) literate (partially or fully) in a domain if they can recognize (the equivalent of “reading”) . . . meanings in the domain. (p. 18)

CD-ROM storybooks, as well as the video games of which Gee (2003) speaks most eloquently and thoughtfully, are semiotic domains that demand a new consideration of literacy, particularly for those whose primary literary functioning is one in these multimodal worlds.

Labbo and Kuhn (1998) predicted that what we currently think of in most common respects as becoming a literate individual would expand to the broader concept of multiple literacies. Geringer’s (2001) study looks at examples of those multiple literacies within children’s award winning picture books. Using Gardner’s (1983) multiple intelligence theory and early childhood development as frameworks for this exploration into multiple literacies, Geringer (2001) develops seven categories of multiple literacies: language, cognitive, physical, natural, aesthetic, affective and social. Using these seven categories in her analysis of the picture books, she concludes that multiple literacies are interconnected and used across all of the intelligences. Her work holds great promise for looking at electronic CD-ROM storybooks within a similar lens and showing their applicability and the variety of literacies they represent, in a similar fashion, across the multiple intelligences.

Kist (2000) takes the concept of multiple literacies and discusses it further through the lens of “new literacy” and his construction of five characteristics of a
pedagogy to support the new literacy. He cites Eisner’s (1997) definition of the new literacy

In order to be read, a poem, an equation, a painting, a dance, a novel, or a contract each requires a distinctive form of literacy, when literacy means, as I intend it to mean, a way of conveying meaning through and recovering meaning from the form of representation in which it appears. (p. 353)

as the pivotal concept around which his pedagogical recommendations are built. These pedagogical recommendations include a rationale for creating a new literacy classroom that encourages ongoing and continuous usage of multiple forms of representation, explicit discussions of symbol usage, past and present, students engaged in ongoing metadialogues in an atmosphere of cognitive pluralism, a balance of individual and collaborative activities and diversified expression in the classroom. Kist draws heavily from the work of the New London Group (1996), an educational think tank whose focus was one of multiliteracies and who considered “all meaning-making (as) multimodal” (p. 81).

Another interesting concept within Kist’s (2000) plan is that of cognitive pluralism. First mentioned within Eisner (1979, 2002) and further explicated in Kist’s citations from John-Steiner (1997); John-Steiner (1997) defines the concept of cognitive pluralism as “one where there is a diversity of representational codes of languages of the mind” (p. xvi). This atmosphere of cognitive pluralism naturally lends itself to students learning the necessary “grammars” of various semiotic systems so that they’re an available reservoir from which students can draw (New London Group, 1996).
Kist (2000) cites Vygotsky, (1934/1986) as he discusses that the sign system choices that individuals make are influenced by early childhood experiences as well as by our culture and history; in a sense by the cognitive apprenticeships that are formed. Young children today are surrounded by computers and electronic communication and delivery devices, including electronic CD-ROM storybooks. Today, as well as when they grow older, the sign systems and multiple literacies present in these storybooks that blend text, graphical image, sound and animated interactivity, will most likely be available for them. Becoming familiar with and integrating these multimodal storybooks within literacy instruction is a responsibility of early literacy educators. As Labbo and Reinking (1999) state, electronic books are just one of the “digital technologies (that) are becoming more specialized and (are) creating their own unique environments for literacy” (p. 482). These unique multimodal environments can be a bridge to unique paths to literacy thus creating a successful learning experience for all of our unique learners.

**Dual-Coding Theory and Multimodal Learning**

The concept of multimodal environments additionally brings to the forefront the usefulness of dual coding theory within this context. “Dual coding theory explains psychological phenomena by the collective action of nonverbal and verbal mental systems that are specialized for the processing of imagery and linguistic information” (Clark & Paivio, 1991, p. 150). In support of this, Leu (2000) states that multimodal learning theories, such as the dual coding theory of Paivio, typically suggest that information presented within multiple modalities maximizes learning for a wider variety of students, some of whom optimize information presented
within a verbal context and others who optimize information presented within an imaginal (visual) context. (p. 752)

The pairing of images and text has been found to have a positive learning effect on students, particularly those with high spatial abilities. In regards to concerns about cognitive load, Neuman (2009) posits in her theory of synergy that “regardless of the medium, children actively search for meaning, they strategically examine and attend to certain features of the medium, they construct and interpret meaning, and they use their prior knowledge in acquiring meaning and making inferences . . . (these) schemas provide a kind of organizational prosthetic…that serves to diminish the information processing load” (p. 49).

Kippley (1994) conducted a study that looked at students’ mental imagery in which both dual coding theory (Clark and Paivio, 1991) and multiple intelligence theory (Gardner, 1983) were used to support the students’ descriptions of their mental imagery. Kippley (1994) found that the third and sixth grade students in her research possessed differing abilities in creating mental images and that these imagery systems could be improved with practice. In addition she found that students’ greater or lesser ability to create mental images affected their capacities for learning in more positive or negative ways. Crucial here was whether or not students used this imaging ability in strategic ways to improve their learning and also whether they applied this imaging ability correctly in specific learning situations. Her findings demonstrate both the importance of the verbal/textual and visual working in consort and also in the abilities for students to
learn from these imageries in improving their learning; one of the tenets of multiple intelligence theory.

Mayer and Sims (1994) proposed a dual coding theory of multimedia learning that suggests that learning occurs “when students use information presented in two or more formats – such as a visually presented animation and verbally presented narration – to construct knowledge” (pp. 389-390). In their short-term pretest control group design study they worked with 86 college students with mixed spatial abilities to determine whether concurrent or successive sharing of visual and verbal content produced greater skill in problem transfer situations. The results showed that concurrent rather than successive sharing of verbal and visual content worked most successfully for students with higher spatial abilities, a finding that supported their dual-coding theory of multimedia learning. Mayer and Sims (1994) perceived that their “work signals the value of instructional materials that maximize the learner’s chances of building connections between words and pictures” (p. 400) and saw the connection between content presented multimodally and learners that possess high spatial ability. Shah and Freedman’s (2003) overview of research on visuospatial cognition in electronic learning also found that “research on visuospatial cognition has demonstrated that learning style (visual vs. Verbal) influences the degree to which visualizations are effective for learners” (p. 320).

**Discussion of Findings and Implications for Current Study**

Semiotics provides a framework within which the conception of literacy is extended “from only the reading and writing of printed materials to include literacy as a multimedia, computer-based composition” (Labbo, 1996, p. 359). The symbol systems
available to young children today in their meaning-making processes include not only traditional oral language and print, but also music, art, icons, scanned images and other varieties of electronic symbols. In considering previous discussions and research cited within this review, it becomes easier to nod in agreement with Labbo and Kuhn (1998) when they note the “possibility that children who have consistent access to electronic symbol making might chart a unique path to literacy, or might follow multiple electronic paths to conventional literacy” (p. 82). These paths to literacy could involve the use of electronic CD-ROM storybooks as bridges from the unique to the more conventional paths of which Labbo and Kuhn (1998) speak.

Computers in general and electronic CD-ROM storybooks in particular can “offer unique support and mediation for children’s construction of meaning about the process of symbol making [and symbol reading]” (Labbo, 1996, p. 381). In support of this construct, Baker (2000) found that her students were using multiple sign systems in multiple ways within their various classroom technology-based literacy activities. Electronic CD-ROM storybooks are uniquely positioned to stand in the gap between traditional print-based literacy and multiple literacies in their multimodal presentation of story. Young children are surrounded by and feel comfortable with computers and this presence and proliferation of technology has a profound influence on the sign-system choices that they make. These sign-system choices will invariably traverse those electronic to a great extent and affect the ways in which the children approach literacy events and experiences.
Added to this environmental impact, consider the unique and multiple paths to literacy that children follow. Consider CD-ROM storybooks’ capability to share verbal and visual content concurrently within their screen environments and the inherent applications here to the findings of Mayer and Sims (1994) in their dual-coding theory of multimedia learning. Their research found what was most beneficial for students with high spatial abilities was a very similar concurrent presentation of verbal and visual content. As one considers multiple intelligence theory in the next section of this review, it is incumbent to reflect upon whether electronic CD-ROM storybooks and their multimodal presentation of story may also prove to have benefits, in comparison with an exclusively textual presentation, for students with spatial and perhaps other intelligence strengths. As the research has demonstrated, these students with high spatial ability have often been found to be visual learners. Through another lens these learners can also be viewed as possessing intelligence strengths that are one representation of the several found in multiple intelligence theory. It is to discussions of this theory that we now turn.

Overview of Research on Multiple Intelligences

Multiple Intelligence Theory and Criticisms Explained and Discussed

This theory of multiple intelligences was developed by Howard Gardner in 1983. Gardner (1999) defines intelligence in general as “a psychological potential to solve problems or to fashion products that are valued in at least one cultural context” (p. 20). In developing his theory, Gardner (1999) proposed eight criteria that each of the potential intelligences in his theory would have to meet. These are explained by Chen (2004):
An intelligence should be isolable in cases of brain damage and there should be evidence for its plausibility and autonomy in evolutionary history. These two criteria were derived from biology.

Two criteria came from developmental psychology: An intelligence has to have a distinct developmental history with a definable set of expert end-state performances and it must exist within special populations such as idiot savants and prodigies.

Two criteria emerged from traditional psychology: An intelligence needs to demonstrate relatively independent operation through the results of specific skill training and also through low correlation to other intelligences in psychometric studies.

Two criteria were derived from logical analysis: An intelligence must have its own identifiable core operation or set of operations and must be susceptible to encoding in a symbol system such as language, numbers, graphics or musical notations. (p. 18)

These criteria assisted Gardner in the determination of abilities that could be considered separate and distinct intelligences.

As a result of these considerations, Gardner (1983) determined originally that seven abilities met these criteria and these abilities became more specifically recognized as his core multiple intelligences: linguistic, logical-mathematical, musical, spatial, bodily-kinesthetic, interpersonal and intrapersonal. He eventually added two additional intelligences to the original seven, that of the naturalist and existential intelligences.
Gardner (1999) claims that everyone has a measure of all of these intelligences but each of us is unique in the intelligence strengths we possess. Veenema and Gardner (1996) discuss that “these intelligences constitute the ways in which individuals take in information, retain and manipulate that information, and demonstrate their understandings (and misunderstandings) to themselves and others” (p. 2-3).

Gardner’s theory is based on two major premises, all people possess some measure of all of these intelligences, and, we each individually will demonstrate a different mix of intelligence strengths that can be considered a profile of sorts. Psychologists as well as researchers from other fields have been somewhat skeptical concerning Gardner’s claims.

Some of these criticisms, as espoused by Klein (2003), point out that Gardner has difficulty proving the validity of any of the distinctive claims that support multiple intelligence theory. Klein admits that many agree with Gardner’s points that “the mind has modules, some of which are dedicated to specific content; that knowledge is fundamentally diverse in kind; and that people differ in their achievements in various domains” (p. 51). But to counter Klein, exclusivity is not something that Gardner stresses in his discussions of multiple intelligence theory; rather that the claims, with which Klein agrees above, are to be considered and included within a discussion of the unique and diverse qualities and capabilities that learners bring to the table in multiplicity, not continuing the discussion with an exclusive and simplistic unidimensional view of standard intelligence theory.
Another of the criticisms of multiple intelligence theory is that it lacks foundations in the empirical literature. Gardner and Moran (2005) consider these criticisms as limited in nature and posit that these critics’ views of science/empirical literature are somewhat naïve and ones that misunderstand the diversity of scientific studies. To substantiate their broader scope view within the empirical studies lens, Gardner & Moran quote Diamond (2005) as he states that “science is misrepresented as ‘the body of knowledge acquired by performing replicated experiments in the laboratory” (p. 17). Diamond is further paraphrased by Gardner and Moran as they go on to explain that

“science is (and has been from its origins) a much broader enterprise: the acquisition of reliable knowledge about the world. Many fields—population, biology, astronomy, epidemiology, geology and paleontology, to name a few—proceed by incorporating and contextualizing relevant empirical findings . . . Science progresses not only through experimentation but also by synthesizing the experimental, observational, and theoretical work of others to build a foundation for future research. MI theory was put forth deliberately as a work of synthesis: a work that organizes and integrates large bodies of empirical work from a variety of disciplines. Rather than utilizing only the experimental and psychometric psychological findings, which were the dominant approach to intelligence at the time, Gardner cast a wide net that included neuroscience, cognitive science, anthropology and evolutionary sciences. This broader view allowed Gardner to
reconceptualize intelligence(s) . . . to understand the concept in a new light free
from the constraints of a single disciplinary lens. (Gardner & Moran, p. 229)

Multiple intelligence theory is not only a look at individual intelligence profiles in
each of the eight areas but also a look at how the interplay between these intelligences
resides within the individual. In his continuing research in this area, Gardner has found
that correlations between intelligences “could imply the concepts of searchlight and
laserlike intelligence profiles—in other words, how the intelligences interact” (p. 230).
Laserlike profiles can exemplify that, within an individual, there can be “one or two
powerful intelligences used in great depth that overshadow the other intelligences” (p.
229). This is a recent development in Gardner’s theory and combines well with his
concept of ‘searchlight profiles’ in which the individual shifts back and forth easily
between intelligences of a similar or equal strength. Gardner has further espoused that
there are ‘overarching intelligence profiles’ that he considers a new and profound
modification of multiple intelligence theory. These more recent developments in
multiple intelligence theory evolution answers some of the critics, such as Klein (2003),
with concerns about the absence of proof for multiple intelligence theory’s distinctive
individualistic claims; there are indeed developments that appear to show an interplay of
intelligences and a movement towards individual intelligence profiles as a holistic
measure of learning and cognitive performance.

Chen (2004) counters some of the criticisms leveled against multiple intelligence
theory as she posits that “a theory [particularly ones in the social sciences] is not
necessarily valuable because it is supported by the results of experimental tests. Rather,
its value depends on the contributions it makes to understanding and to practice in the field” (p. 22). In support of this, Gardner (1999) has found that “educators around the world have embraced it. MI theory not only comports with their intuitions that children are smart in different ways; it also holds out hope that more students can be reached more effectively if their favored ways of knowing are taken into account in curriculum, instruction and assessment” (p. 21).

Within the discussion of the various criticisms we have seen that there remain some inherent truths within multiple intelligence theory that even critics will admit. The mind indeed has some variance of explicit modules dedicated in some fashion to specific bodies of content. Information of different kinds is processed differently within the complexity of the brain’s ‘compartments’. And critics admit that individuals are different in their levels of achievement in various cognitive domains and that knowledge, in and of itself, is complex and very diverse. These areas of agreement are all tenets which drew the researcher to multiple intelligence theory as a possible explanation and also a support for students who learn differently and how those differences in learning might be supported by the use of technology within literacy instruction. Though multiple intelligence theory remains within an evolutionary and developmental process, there are truths upon which we can move forward. As Gardner (2001) states, “new technologies make the materials vivid, easy to access and fun to play with and they readily address the multiple ways of knowing that humans possess” (p. 35).

One of the potential ways in which ‘favored ways of knowing’ can be taken into account is by the integration of CD-ROM storybooks within reading instructional
strategies. In their multimodal presentations, CD-ROM storybooks encourage and facilitate multiple ways of knowing and multiple literacies. And, as a result, those unique pathways to literacy, of which Labbo & Kuhn (1998) speak, can be respected and enhanced.

In looking at each of these intelligences individually we see a pattern for understanding the theories behind each. S. Branton Shearer, creator of the MIDAS (Multiple Intelligence Developmental Assessment Scales) (1996) defines the differing intelligences as follows:

- Musical is the ability to think in sounds, rhythms, melodies and rhymes.
- Kinesthetic is to think in movements and to use the body in skilled and complicated ways for expressive and goal directed activities.
- Logical-Mathematical is to think of cause and effect connections and to understand relationships among actions, objects or ideas. Spatial is to think in pictures and to perceive the visual world. Linguistic is to think in words and to use language to express and understand complex meanings. Interpersonal is to think about and understand another person. Intrapersonal is to think about and understand oneself. Naturalist is to understand the natural world including plants, animals and scientific studies. (Shearer, 2005, p.xx)

Understanding the specificities within each of these individual intelligences may help educators to plan activities within the classroom that are more sensitive to and supportive of different kinds of learners and the multiple intelligences they bring into each classroom. What can result is an “individually
configured education – an education that takes individual differences seriously and . . . crafts practices that serve different kinds of minds equally well . . . the crucial ingredient is a commitment to knowing the minds – the persons – of individual students. (Gardner, 1999, p. 151)

This individualization of instruction is key in assisting students to become the best that they can be, not only in developing their intelligence strengths but also in developing other intelligences they possess, as well. Electronic CD-ROM storybooks can play a unique role in this maximization of strategies for diverse instruction. Students can read, hear and interact physically with the story in ways not possible with static print text presented unimodally within conventional print-based books. These CD-ROM storybooks can, however, provide a bridge to print in pairing the electronic story with its print counterpart. This bridging can assist in the development of more latent intelligences that students may possess.

The individualization of intelligence strengths opens the door for consideration that instruction should be individualized, differentiated, to maximize learning according to particular intelligence strengths. Students with different strengths approach content learning differentially, whether that be math, science or reading. Kist (2000) recognized this in asserting that our “unique blend of intelligences that we each have would include a bent for seeing the world and expressing ourselves in individualized ways” (p. 714). Green (1999) goes a bit further in her interpretation that Gardner “asserts the purpose of an education should be tied to an understanding of how minds differ from each other and calls for individual centered schools geared to optimal development of each student’s
cognitive profile” (p. 683). In focusing this concept toward the consideration of and application to reading instruction, Melton, Pickett and Sherer (1999) believe that “the successful reading program is one in which a variety of techniques are incorporated. Such a program will include attention to many disciplines . . . (and) . . . will engage students through active participation . . .” (p. 15). Electronic CD-ROM storybooks are yet one additional technique that can be incorporated within reading instruction to assist in meeting the needs of students with differing intelligence strengths. Looking for possibilities in tailoring these various reading instruction strategies to the needs of individual students opens the doors for partnership with multiple intelligence theory.

**Multiple Intelligence Theory and Reading Instruction**

One justification for consideration and implementation of this partnership is the relationship of the brain to reading. Teele (2004) posits that because dyslexic readers experience less activation in the left temporal region and more in the occipital and prefrontal regions (of the brain), they may need to learn through more visual and spatial methods. Dyslexics may be stronger in spatial intelligence than in linguistic intelligence. (p. 40).

Teele (2004) cites the work of Cytowic (1996) and the Center for Applied Special Technology (CAST) as she discusses the concept of the three brain systems – the recognition system, the strategic system and the affective system – and the potential connection they have to the variety of activities that comprise reading processes. Within this framework, the recognition system represents parts of the brain that have a role in pattern identification such as those found in letters and words. Recognizing and
processing information concerning letters and recognition of colors, shapes, etc. Both occur in separate areas of the brain and as a result may involve different intelligences such as the linguistic, logical-mathematical and spatial intelligences. By the use of a variety of reading instructional methods, which might include electronic CD-ROM storybooks, teachers can respect the different intelligence strengths and facilitate their students’ literacy learning. The strategic brain system relates to pattern development in a variety of instructional areas. This is another area in which CD-ROM storybooks can facilitate and offer new ways of learning in the opportunities that they provide for interactivity and engagement with the stories that they present. In fact, Teele (2004) agrees and asserts that “computer-assisted instruction can be used to support the reading process by appealing to different intelligences . . . interactive talking books . . . (have) . . . all of the intelligences represented in the activities presented . . .” (p. 155).

Teele (1992) created the Teele Inventory for Multiple Intelligences (TIMI) as a means to determine a child’s dominant intelligences. This inventory is a forced-choice instrument that utilizes fifty-six numbered pictures of panda bears that represent individualized characteristics of Gardner’s (1983) original seven intelligences.

Teele’s (2004) analysis of over 6,000 student profiles has shown a trend that indicates that certain intelligences tend to be dominant within certain grade levels. Kindergarten students’ top two dominant intelligences are spatial and bodily-kinesthetic; First Graders’ are spatial and logical-mathematical and Second and Third Graders’ are both spatial and bodily-kinesthetic. Considering Teele’s (2004) discovery in this area, it appears that spatial and bodily-kinesthetic intelligences have strong representation among
primary grade children. In addition, Melton, Pickett and Sherer (1999) report that the “poor reader often is a student…highly attuned to spatial or bodily intelligences” (p. 12). In regards to the population of Kindergarten children within this researcher’s study, it appears that investigating their combined cognitive and metacognitive levels of response to electronic CD-ROM storybooks in relationship to either their spatial and bodily-kinesthetic intelligence strengths may prove to be a helpful addition to the research literature. Melton, Pickett and Sherer (1999) state that “a reading program based on MI (multiple intelligences) theory encourages students to learn to read in ways that make reading skills most meaningful to them.” (p. 10). Teaching to a child’s intelligence strengths by providing a variety of instructional strategies in early reading instruction, instructional strategies which can include CD-ROM storybooks, may facilitate children with differentiated intelligences in learning to read.

**Multiple Intelligence Theory and Technology**

Electronic CD-ROM storybook technology is an example of one of the technologies mentioned in Sweeder, Bednar and Ryan’s (1998) claim that “product technologies are natural components to MI theory because they enable learners to access and apply more readily their natural learning styles or preferences which . . . emanates from one or more of their personal intelligences…by conjoining MI theory with a variety of product technologies, we believe that we are more likely to engage our students and assist them in comprehending course content” (p. 274). Veenema and Gardner (1996) echo this sentiment in their thought that “if we believe that the mind is neither singular nor revealed in a single language of representation, our use of technologies should reflect
that understanding . . . technologies like CD-ROM that include a variety of media may well be able to help more students form rich representations . . . and cultivate deeper understandings” (p. 6-7). Though not specifically related to electronic CD-ROM storybooks, Osciak and Milheim (2001) deal with a parallel and related concept in their discussions of how multiple intelligence theory has direct applications to on-line learning experiences. They see applications of this theory within e-mail communications, listservs, chat forums, videoconferencing and class web sites. In each, they see the potential and the possibilities for various, and sometimes all, intelligence strengths to be represented and cultivated.

In a web site usability study within the light of multiple intelligence theory, Ashmore (2003) investigated web site usability with twelve preschool and primary grade children. She looked at the different kinds of usability issues children have when using web sites, effectiveness of web design elements, what role intelligence might play in using web sites and other factors that might affect usability of the web by children. In this qualitative study, Ashmore (2003) used the Teele Inventory for Multiple Intelligences instrument, interviews, observations, questionnaires and other various measures to gather pertinent data in the children’s use of two selected children’s web sites. Among other findings, Ashmore (2003) determined that design features that were most engaging to children in terms of their spatial and kinesthetic intelligences were large clickable areas and navigation metaphors. These engaging elements available in the children’s web sites used within this study are also available plentifully within most, if not all, electronic CD-ROM storybooks.
Multiple Intelligence Theory and Early Childhood Education

Madsen (1997), Vialle (1991) and Salgado-Gama (1991) looked at applications of multiple intelligence theory within early childhood programs under different circumstances and purposes. Vialle (1991) constructed case studies of five African-American children from low-socioeconomic day-care settings to determine whether these four-and-five-year-old children exhibited strengths and weaknesses represented across Gardner’s (1983) seven intelligences and how these strengths and weaknesses potentially had an effect on their problem-solving approach. Vialle (1991) did find Gardner’s (1983) multiple intelligence theory as a useful and applicable framework within her research context and found this theory particularly useful and important for children whose strengths lie outside the traditional linguistic and logical-mathematical intelligences. Salgado-Gama (1991) blends elements of Gardner’s (1983) multiple intelligence theory with Bloom’s Taxonomy of Educational Objectives in her creation of an early childhood curriculum for Brazilian preschoolers that challenges a child’s individual intelligences, that caters to their differing levels of capability and that considers the cultural considerations that preschoolers with gifts and talents in different intelligence and knowledge domains may encounter. Salgado-Gama (1991) considered the tri-partite importance of content, process and learning environment as central pieces in assuring an equitable curriculum for preschoolers of all intelligence strengths. Madsen’s (1997) grounded theory qualitative study attempted to determine whether multiple intelligence strengths were exhibited by two to four year olds within a university child care center and how these strengths, if exhibited, had any relationship to
a particular learning style model. Within her study, Madsen (1997) observed twelve children during their self-selection play time and in her findings concluded that the individual children did indeed exhibit characteristics for at least three of Gardner’s (1983) identified intelligences that she paired with specific individual learning styles. Madsen’s (1997) research holds promise within the light of Denig’s (2004) thought that “if we examine multiple intelligences and learning styles as different and complementary, we may be able to create a research base that demonstrates an increase in student learning across the whole spectrum of intelligences, including standardized achievement tests” (p. 106).

All of these studies with preschoolers have shown the importance of creating curricula and environments that cater to and respect the individual learning needs of each and every child. A part of that consideration includes the distinct possibility that some of our children need the audio, visual and kinesthetic support that electronic CD-ROM storybooks bring to the equation. Vialle (1991) noted the importance, particularly, of Gardner’s (1983) theory for children who fall outside of the “normal” intelligences that classrooms are usually structured to support. Madsen (1997) noted the connection of children’s multiple intelligence strengths to their learning styles. And Salgado-Gama (1991) noted the importance of the content, process and environment working together to maximize the educational experience for the child where they are individually, with the particular strengths that they possess. In each of these studies, electronic CD-ROM storybooks have the potential to play a role in their support for the children who may be outside the “norm” in reading instruction strategies.
In a similar vein to Salgado-Gama (1991), Noble’s (2004) research combined the concepts of multiple intelligence theory and the revised Bloom’s Taxonomy (Anderson and Krathwohl, 2001). Noble (2004) integrated the two concepts within a classification system that placed the multiple intelligences on a horizontal dimension and the taxonomy’s differing levels of cognitive processes on the vertical. Noble (2004) employed the resulting matrix over eighteen months with sixteen elementary school teachers as a tool in planning their learning centers’ curricula. Noble (2004) used both quantitative and qualitative measures which included questionnaires, focus group discussions, interviews and the researcher’s field diary. The results demonstrated that teachers believed the incorporation of the two concepts within the matrix assisted them in facilitating the individualized learning needs of their students. These results supported Gardner’s (1995) belief that:

A pluralist approach opens up the possibility that students can display their new understandings – as well as their continuing difficulties – in ways that are comfortable for them and accessible to others . . . students secure a sense of what it is like to be an expert when they behold that a teacher can represent knowledge in a number of different ways. They discover that they themselves are also capable of more than a single representation of a specified content. (p. 208)

**Discussion of Findings and Implications for Current Study**

This pluralistic approach is one that can include the use of electronic CD-ROM storybooks within the greater reading instruction strategies for students in the classroom. The National Reading Panel Report (2000) found “agreement in the experimental
literature that computer technology can be used to deliver a variety of styles of reading instruction successfully” (p. 6-9). Specifically, one implication was that reading instruction could benefit from multimedia computer software. The Report (2000) stated that “there appear to be many students who benefit from the addition of multimedia instruction to a conventional curriculum . . . when multimedia software is available and appropriate, it should be exploited” (p. 6-8). At the time of the report in 2000, the Panel found a dearth of research in the area of computer technology and reading instruction. One reason for this was the Panel’s perception that the general feeling by reading researchers was that technology was not a topic they considered in the mainstream of reading research.

Research on the use of electronic CD-ROM storybooks within the classroom and the support that they can potentially provide for students with various intelligence strengths is needed to assist in convincing teachers of the need to include these storybooks within their reading instruction.

The cognitivist’s acknowledgement of different kinds of minds opens up enormous educational opportunities. If individuals do differ from one another and if we want to reach as many of them as possible, it makes little sense to treat everyone in a one-size-fits-all manner. Rather, we need to understand the specific minds involved in an educational encounter; and insofar as possible, we should base our education, including choices of technology, on that knowledge.

(Veenema & Gardner, 1996, p. 3)
In consideration of multiple literacies and the role that it plays with incorporating the use of electronic CD-ROM storybooks within reading instruction, Turbill’s (2001) research found an interesting parallel between Clay’s (1979) Concepts of Print and what Turbill (2003) coined as Concepts of Screen. Turbill’s (2001) concern that Kindergarten teachers were using too limited a definition of literacy came through clearly in her results as she commented that “the children’s…reading of the visuals (in the electronic CD-ROM storybooks) and their discussions around these may not have been different from what we might expect of book-based reading of the illustrations, but the children were creating meaning from these visuals and animations. This form of reading need(s) to be incorporated into both the teacher’s definition of reading and her classroom practice” (p. 275). As Eisner (2004) states:

For me there is something intuitively right about recognizing that people differ in the ways in which they function best. There is something socially right about the idea that children and adolescents should be given an opportunity to shine in classrooms in which their particular strengths can be nurtured and made public. In both of these ideas, equity, educationally speaking, requires more than having the opportunity to cross the school’s threshold; it includes having the opportunities once that threshold is crossed to find a setting that is sensitive and responsive to the forms of intelligence individuals possess (p. 33)

Incorporating the use of electronic CD-ROM storybooks within reading instruction and the consideration of the multiple literacies and multiple intelligences that are tapped and respected within this process provide the opportunities for students’ intelligence strengths
and literacy growth to be nurtured. They also help in making possible the provision, existence and maintenance of these sensitive and responsive settings, of which Eisner (2004) speaks, within which individual children with differing intelligence strengths can thrive and grow.

**Summary**

The purpose of this study, as previously stated, is to investigate and explore potential relationships between Kindergartners’ levels of interactions with CD-ROM storybooks and their individual multiple intelligence strengths. As one can see through the stories constructed by the research studies investigated herein, learning more about how young children interact with electronic CD-ROM storybooks through the lens of multiple intelligence theory may hold great potential for maximizing reading instruction for the individual child. This study hopes to provide one empirical piece within a growing and continually evolving research puzzle.

This overview of research has been divided into four sections which began with a look at the history of the use of computer technology within reading instruction. Following this historical perspective was a look at the research surrounding electronic CD-ROM storybooks. The concept of multiplicities comprised the next section and included research studies that focused on semiotics and multiple sign systems, dual-coding theory and multiple literacies. Finally, an overview of various research covering multiple intelligence theory and its applications was presented.

To assist in more clearly recognizing the necessity for this research study, it is important to connect the explication of the important role that computer technology has
played historically within reading instruction with the potential possibilities for its
continued and more enlightened and informed use in the future. As well, the potential
inherent in electronic CD-ROM storybooks and their ability to play a strong and
consistent role within the context of literacy and reading instructional strategies has been
demonstrated. Discovered is the logic and respect for learning differences inherent
within the concept of multiplicities and its manifestations within semiotics and multiple
sign-systems, dual-coding theory and multiple literacies. Finally, a strong and abiding
respect for learning differences rests comfortably alongside the theory of multiple
intelligences and has enlightened us concerning how incorporating this approach within
multimedia instructional strategies, such as the use of electronic CD-ROM storybooks
within reading instruction, has the potential to make a difference for the individual
learner.

Labbo (1996) posits that “semiotics provides a framework for taking a wider view
of literacy . . . from only the reading and writing of printed materials to include literacy as
a multimedia, computer-based composition” (p. 359). Not only does semiotics and the
concepts inherent within our discussions of multiplicities provide this framework, but
multiple intelligence theory does as well in its insistence that intelligence does not come
in only one flavor, but in a variety of flavors. Chen (2004) insists that “MI theory can be
applied to the development of instructional techniques . . . [in its ability to] . . . provide
multiple entry points to the study of a particular topic . . . by using different media . . .” (p.
21). The application of multiple intelligence theory and the integration of multimedia
within reading instruction strategies has the potential to provide these multiple entry
points of which Chen (2004) speaks. This research study’s investigation and exploration of the potential relationships between Kindergartners’ levels of interactions with CD-ROM storybooks and their individual multiple intelligence strengths will add to the small, yet growing, body of research seeking to investigate the possibilities inherent within this blend of electronic CD-ROM storybooks, the studies of multiplicities and the theory of multiple intelligences.
CHAPTER III

METHODOLOGY

Research Design

This mixed-methods research design attempts to explore the potential relationships between Kindergartners’ eight individual intelligence strengths and their combined cognitive and metacognitive levels of interaction with an electronic CD-ROM storybook. This design methodology becomes “a procedure for collecting both quantitative and qualitative data in a single study, and analyzing and reporting this data based on a priority and sequence of information” (Creswell, 2002, p. 560). Blending both a quantitative correlational research design and a qualitative case study/participant-observer design, this mixed-methods study is primarily a concurrent triangulation design in which both the quantitative and qualitative data are collected simultaneously, results are merged and the two data sets combined are analyzed to present a more complete view of the phenomena under study.

There are two broad research questions addressed simultaneously throughout the study:

1. What is the relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their eight individual multiple intelligence strengths?
2. What apparent observed meaning making, from both the participant and researcher perspectives, is occurring within select participants individually as they interact with an electronic CD-ROM storybook?

To represent quantitative data, a correlational study design was chosen because as a part of the broader research tradition known as comparative research, these studies allow for the examination of potential relationships between the variables under study. Within the correlational model, there were eight hypotheses that determined to show that (1) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their interpersonal intelligence strength, (2) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their intrapersonal intelligence strength, (3) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their kinesthetic intelligence strength, (4) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their linguistic intelligence strength, (5) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their mathematical intelligence strength, (6) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their musical intelligence strength, (7) there was a linear relationship between students’ combined cognitive and metacognitive level of interaction with
electronic CD-ROM storybooks and their naturalist intelligence strength and that
(8) there was a linear relationship between students’ combined cognitive and
metacognitive level of interaction with electronic CD-ROM storybooks and their spatial
intelligence strength.

Inherent within the study is the expectation that participants’ individual
intelligence strengths would show greater or lesser positive linear relationships in variant
measures and would demonstrate differing interactions with the CD-ROM storybooks
that affects both frequency and variances in cognitive and metacognitive levels. The
combination of visual and verbal representation of content in the CD-ROM storybooks as
well as their interactive hands-on capabilities may have the potential to enhance or
detract from the combined cognitive and metacognitive response of students possessing
specific intelligence strengths.

Time sampling and frequency-count recording observations of these interactions
provided not only quantitative data for the rubrics but also qualitative descriptions of how
individual students bring meaning to the CD-ROM storybook viewing/interaction
experience. Combining both descriptive data gained from qualitative observations with
the quantitative numeric data gained from the correlations of the participants’ individual
intelligence strength scores with the rubric interaction scores triangulated the data. This
triangulation provides a more complete description and analysis of the data; one that
Miles and Huberman (1994) describe as “a very powerful mix” (p. 42).

The selection and use of qualitative and quantitative data in respect to students’
spatial and kinesthetic strengths in particular is related to associated bodies of related and
potentially relevant research. In terms of spatial intelligence strengths, Mayer and Sims (1994) proposed a dual coding theory of multimedia learning that suggests that learning occurs “when students use information presented in two or more formats – such as a visually presented animation and verbally presented narration – to construct knowledge” (pp. 389-390). Mayer & Sims (1994) perceived that their “work signals the value of instructional materials that maximize the learner’s chances of building connections between words and pictures” (p. 400) and saw a connection between content presented multimodally and learners that possess high spatial ability. Moreover, Shah and Freedman’s (2003) overview of research on visuospatial cognition in electronic learning also found that “research on visuospatial cognition has demonstrated that learning style (visual vs. verbal) influences the degree to which visualizations are effective for learners” (p. 320). Research on individual learning styles has demonstrated relationships between student learning styles and intelligence strengths (Madsen, 1997; Denig, 2004).

Electronic CD-ROM storybooks’ capability to share verbal and visual content concurrently within their screen environments holds inherent applications akin to the findings of Mayer and Sims (1994) in their dual-coding theory of multimedia learning. Their research found that what was most beneficial for students with high spatial abilities was a very similar concurrent presentation of verbal and visual content. In relation to and consideration of multiple intelligence theory, it might also be incumbent in future research to reflect upon whether electronic CD-ROM storybooks and their multimodal presentation of story may also prove to have increased and more productive benefits, in comparison to an exclusively textual presentation, for students with spatial and perhaps
other intelligence strengths. As the research has demonstrated, students with high spatial
ability have often been found to be visual learners. Through another lens these learners
can also be viewed as possessing intelligence strengths that could be one representation
of the several found in multiple intelligence theory.

In regards to students’ kinesthetic intelligence strengths and the higher propensity
toward a need for physical involvement and activity in learning tasks, researchers have
found that perhaps the most significant contribution of electronic text to reading
instruction is the amount of active learner control provided. “CD-ROM storybooks
provide a multi-sensory learning experience that enables students to literally interact with
the text and the illustrations and to actively process the text, both of which lead to a
personal understanding of text” (Matthew, 1996, p. 267). Matthew (1997) also
determined that “using both electronic and print texts as complements to each other
facilitates the different learning styles found in classrooms” (p. 272). Could they
facilitate the different measures of intelligence strengths found in classrooms as well?

In her website usability study within the lens of multiple intelligence theory,
Ashmore (2003) determined that design features that were most engaging to children in
terms of their spatial and kinesthetic intelligences were large clickable areas and
navigation metaphors. These engaging elements available in the children’s web sites
used within this study are also available plentifully within most, if not all, electronic CD-
ROM storybooks. Physical interaction with the electronic CD-ROM storybooks through
clickable ‘hot-spots’ may provide the active learner control that makes a difference for
students with higher kinesthetic intelligence strengths.
Can these various supports provided by electronic CD-ROM storybooks be more highly attuned to and maximized by students with greater spatial and kinesthetic intelligence strengths? Chu (1995) and James (1999) found similarly that electronic CD-ROM storybooks, by virtue of their interactivity and design, encourage active reader response from their participants. The research of Mayer and Sims (1994) and Shah and Freedman (2003) combine with that of Matthew (1996, 1997), Chu (1995) and James (1999) to provide enough impetus to investigate the potential relationships between student spatial and kinesthetic intelligence strengths individually and their interactions with and response to electronic CD-ROM storybooks. Active reader response and the combined positive effects of the visual and verbal coding processes may hold keys of understanding in these areas.

Case study designs do not hold inherent implications for particular data collection models (Yin, 1994) and hence provide a standard of flexibility within mixed-method studies. A single case study design was selected within this concurrent mixed-methods study in order to provide an alternative venue for classroom data collection and analysis. This will occur through a lens examining possible relationships between embedded pre-defined student exemplars’ intelligence strengths and their combined cognitive and metacognitive interactions with CDROM storybooks cases and these in relation to the specific theoretical hypotheses as set forth within this study. Tellis (1997) states that “the quintessential characteristic of case studies is that they strive towards a holistic understanding of cultural systems of action . . . (which) refer to sets of interrelated activities engaged in by the actors in a social situation” (online). The interrelated
cognitive and metacognitive meaning-making activities of the child actors with their individual intelligence strength profiles in relation to their interactions with CDROM storybooks is the cultural system of action that is of interest within this study. In addition, the multiple perspectives of the children, their parents and teachers, as well as the researcher, provides for the varied multi-perspectival analyses inherent within case studies.

Within this case study model, the quantitative data gathered for each student will provide differing levels of information from which a few selective exemplar student cases will be chosen. Analysis of these exemplar cases will provide more in-depth information and a venue from which the theoretical stances of this study can be examined more closely.

Sample

In terms of maximizing both internal and external validity considerations probability sampling involving random selection has been held as the acceptable standard. However, within educational environments, human subject consent constraints result in what Borg (1989) describes as the entirety of educational research being conducted via the use of volunteers. With that said, it becomes evident that a modification of or substitution for probability sampling will most likely occur in a number of research settings. The reverse of probability sampling is that of purposive sampling.

“The logic and power of purposive sampling lies in selecting information-rich cases for study in depth’ (Patton, 1990, p. 169) with an underlying focus on intentionally selecting specific cases that will provide the most information for the questions under
study’ (Kemper, Stringfield & Teddlie, 2003, p. 279). Though traditionally used frequently within the smaller sample sizes found within the qualitative research tradition, purposive sampling techniques are also found and used quite commonly within mixed-methods studies as well (Kemper, Stringfield & Teddlie, 2003).

In this particular study, it was perceived, based on personal in-depth experiences within a university based technology classroom during a pilot study, that the population chosen would be one of those specific information-rich cases that would perhaps serve as exemplars to provide the information needed for the research questions posed by this study. With this in mind, the population of interest within this study are two groups of five year old Kindergarten students within the Midwest of the United States. Correlational studies typically utilize a minimum of 30 as a reliable sample size (Creswell, 2002). The classrooms in question would provide the necessary numbers of students to meet this reliability requirement. Within this population, the researcher employed random purposive sampling to extract a random sample of sixteen students from within each classroom group population for detailed one-on-one observation. This technique served to add an element of trustworthiness to the findings and help to explain why certain cases were chosen for more detailed observation and study. In addition, specific quantitative data obtained through research instruments within the study was used to select exemplar students from this sample for more in-depth study as embedded units of analysis.
Instruments

Students’ individual intelligence strengths were assessed via use of the Multiple Intelligence Developmental Assessment Scales (MIDAS) (Shearer, c. 1994-2002). Due to the young age of the participants, a particular version of the assessment instrument, MIDAS-KIDS/My Young Child, was used. This version is in the form of a structured interview with the parent or between parent and child and consists of seventy questions that assess parents’ perceptions of Gardner’s (1999) eight multiple intelligences; spatial, kinesthetic, linguistic, math-logical, intrapersonal, interpersonal, musical and naturalist intelligence strengths, as represented within their child. In addition, for comparison purposes of potential interest, a beta version of the Multiple Intelligence Developmental Assessment Scales (MIDAS) (Shearer, c. 1994-2002) under development is a Teacher MIDAS. This version is in the form of a structured interview with the teacher and consists of 32 questions that assess teachers’ perceptions of Gardner’s (1999) eight multiple intelligences; spatial, kinesthetic, linguistic, math-logical, intrapersonal, interpersonal, musical and naturalist intelligence strengths, as represented within their student. The results of these instruments will be compared informally.

Multiple interview formats were conducted for different purposes during the course of the study. Focused interviews with pre-established protocol were conducted with the classroom teachers during the course of the study. In addition, structured paper interviews with a pre-established protocol were conducted with the parents and a more informal conversation with the classroom teachers to capture their perspectives on the MIDAS profile results for each child and how accurately the profiles represented each
child’s strengths and weaknesses. At the study’s conclusion and during the emergent data analysis, open-ended interviews were conducted with teachers. These key informants were asked for comments about study results in-process as well as to provide insight into exemplar data results and conclusions by the researcher within the data analysis process.

The CD-ROM storybook selected for this study, *Stellaluna* (Random House-Broderbund, 1996), was chosen because of the textual qualities it embodies. Textual analysis demonstrated it to be a “considerate text”, one which facilitates a child’s story understanding and recall through multimedia features holding a strong and supportive relationship to the story structure itself (Labbo & Kuhn, 2000). In response to hesitations concerning cognitive load when using CD-ROM storybooks, Neuman’s (2009) theory of synergy posits that “regardless of the medium, children actively search for meaning, they strategically examine and attend to certain features of the medium, they construct and interpret meaning, and they use their prior knowledge in acquiring meaning and making inferences…(these) schemas provide a kind of organizational prosthetic . . . that serves to diminish the information processing load” (p. 49).

Students’ level of interactions with the selected CD-ROM storybook were evaluated according to a rubric developed conceptually according to the Wittrock Generative Learning Model as used and applied by Labbo and Kuhn (2000) within their research. This model (Appendix) is represented by five categories of possible student response to CD-ROM storybooks, attentive/perceptual, affective, cognitive, CD
procedures and metacognitive. The original instrument was used within a qualitative case study design.

For the intent of this study, this qualitative model was adapted by the researcher to provide a means of assessing level of interaction via providing ordinal scale data for each of the five categories. During timed observations, each student response/interaction during the use of the CD-ROM storybook was recorded by the researcher with a tally mark and assigned within the appropriate category on the instrument. These observations and their accompanying responses/interactions on screen were also videotaped from the rear in order to observe/record the response of students on screen while reading/interacting with the CD-ROM storybook. These videotapes served as a means of triangulation for the observational rubric data collected.

The individual cognitive and metacognitive categories are of key interest for the rich qualitative description opportunities they provide for the specific student interactions. Even so, as noted in Labbo and Kuhn (2000), the researcher decided to approach the quantitative ordinal data gained from student observations within both the cognitive and metacognitive categories in a combined manner. For this purpose, looking at these categories within a unified framework such as this represents student meaning making processes as a whole, similar to that found in Wittrock’s (1986) conceptualization of ‘knowledge processes.’

**Reliability and Validity of the Measures**

In terms of validity and reliability, strong internal consistency for all eight scales of the MIDAS-KIDS/My Young Child (Shearer, c. 1994-2002) has been reported.
Reliability estimates range from a low of .76 to a high of .87. Construct validity was reported with an inter-scale correlation range from .43 to .79 and a mean of .62. Overall, the strength and pattern of correlations for concurrent validity tests yielded statistically significant results. MIDAS scales were compared with scores children received on the Wechsler Intelligence Scale-Revised (WISC-R). Correlations between the Linguistic Scale and Verbal IQ were $r=.60$ and between the Logical Scale and Full Scale IQ were .54. Predictive validity showed high mean scores ranging from 59-73% with a mean of 63%. Low group means ranged from 42-50% with a mean of 40%. The author suggests that these are within an expected range that predicts that a score of 60% and above is considered high and 40% and below considered low range.

The *Stellaluna* (Random House-Broderbund, 1996) CD-ROM storybook was selected for this study based on its determination as a “considerate text”. The validity of this selection arises from a textual analysis found within a qualitative research study (Labbo & Kuhn, 2000). Though reliability and validity of instruments are determined differently in qualitative than within quantitative research, the researchers demonstrated these constructs within certain procedures that they followed. Their textual analysis procedures involved two CD-ROM storybooks which could be interpreted as falling within the category of data triangulation. They also built this analysis upon the existing and respected theories of other researchers detailed within their study. Constant-comparative analysis also assisted in their instrument creation. The inter-rater reliability on their instrument was 91% agreement. Analysis of the coding sheets for their instrument showed distinct patterns of relationships that enabled them to make a
distinction between *Stellaluna* (Random-House-Broderbund, c. 1996) and the other CD-ROM storybook under analysis and provide the designation of considerate versus inconsiderate text. Reliability was demonstrated within this qualitative process partially through detailed methodology, prolonged engagement and persistent observation, clearly stated questions and the pursuit of answers and a predetermined focus for this part of their study.

Within this study, inter-rater reliability was established through the viewing of 20% of the student sample observation videos by two colleagues with 20 years combined experience working with young children and technology. They were provided with specific instructions in regards to the rubric and its use and definitions of terms within the rubric itself. Original agreement was 76% but further discussion, explanation and reviewing the videos at points of disagreement yielded a 90% inter-rater agreement. As stated by Saini, Sehgal & Sethi (2008), “each of the reliability estimators has certain advantages and disadvantages. Inter-rater reliability is one of the best ways to estimate reliability when your measure is an observation…as an alternative, you could look at the correlation of ratings of the same single observer repeated on two different occasions” (p. 59).

Phase Two of Labbo and Kuhn’s research (2000) involved a case study of a Kindergarten student interacting with *Stellaluna* (Random-House-Broderbund, c. 1996) and another CD-ROM storybook. This case study generated their rubric adaptation of the Wittrock Generative Learning Model (Appendix) as a lens for evaluating a child’s response to/interaction with CD-ROM storybooks. Measures of validity and reliability in
qualitative studies differ from those found in quantitative research. A few evaluative strategies may be used to gauge validity here. One of these is to recognize that this particular study was one within a broader educational context that Labbo and Kuhn (2000) were researching and has been presented in such a way that facilitated their research being used and replicated by others. Another measure of validity within this qualitative genre is to note that their work is well documented and that their instrument appears to be accurate within previous respected theories of learning and instruction, much as was true with their textual analysis. In addition, the researchers noted the limitations of generalizability within their study as a whole. Reliability here was gauged via their prolonged engagement and persistent observation of one year’s time at the research site and within which this instrument was adapted and tested. Additionally, the instrument creation was detailed with a clear path of logic and focal questions clearly stated from the onset of the research.

In terms of case studies, Yin (1994) considers construct, internal and external validities and reliability to be key test components for these study designs. Construct validity concerns instrumentation used within the study and its ability to accurately communicate and relate data measurements. One way for a better assurance of data integrity is to plan multiple measures of data within the study design. Within this study, quantitative and qualitative observational data collection via the rubric protocol will be supported through videotaping the computer screens and capturing both student computer navigations and verbal interactions during the timed observations. Another multiple measure built into the study design is the MIDAS instrument completion by both parents.
and teachers. This will provide an opportunity to triangulate and compare student profile data garnered from each perspective on the individual children within the study.

Internal validity of case studies is improved, and achieved, through multiple strategies which include “the specification of the units of analysis, the development of a priori . . . theories and the collection and analysis of data to test . . . (these theories)” (Yin, 1994, p. 136). Within this study, the units of analysis are the Kindergarten classrooms and then within these single cases, the embedded analysis of the exemplar students selected by the specific criteria delineated. Theoretical hypotheses have been developed and stated speculating that relationships of potentially varying measures exist between specific intelligence strengths and cognitive and metacognitive interactions with CD-ROM storybooks. External validity within case studies is present within the “specification of theoretical relationships from which generalizations can then be made” (Yin, 1994, p. 136).

Reliability within case studies is demonstrated via use of established formal protocols (Yin, 1994) which help to assure that the same procedures are followed within each incidence of the case study. Within this research design are established procedures for exemplar case selection as well as formal protocols for data collection and data analysis. Pre-established and selected specific quantitative and qualitative data instrumentation measures are consistent for all student, parent and teacher participants. In keeping with good research design, these strategies are employed in an attempt to assure the reliability of the study results.
Pilot Research

In preparation for dissertation research, this researcher tested the proposed study’s early theoretical and methodological viability through means of a pilot study that occurred during October and November 2005. The preparations for this study began in Spring 2005 with plans for exploratory pilot research. An explanation of the pilot study’s design and intent was provided in writing to the early childhood program’s Director and the classroom teacher. The teacher expressed interest in participating with her class. Pertinent permissions from individual student families, as appropriate, as well as the Human Subject Review application, were completed in Fall 2005. In October 2005, the researcher met with the Director and teacher and provided them with letters to distribute to the students’ parents within which the research process was explained fully. Parents were also given information on the use and administration of the MIDAS-KIDS/My Young Child instrument (Shearer, c. 1994-2002). Parents were asked to complete the instrument by responding to the instrument questions directly according to their beliefs of their child’s abilities for each of the questions and return these results to the teacher within one week. The researcher acquired the completed instruments and assessment results were scored not only by the instrument creator, Dr. C. Branton Shearer via scanned data sheets, but also scored manually by the researcher via data insertion into an online MIDAS assessment and administration tool.

In November 2005, the researcher spent time within the classroom for portions of two days per week over four weeks. Part of this time was used to become acquainted with the children, teachers and classroom practice as well as to gradually present to the
children a sequential introduction to storybooks in electronic formats. The researcher shared print storybooks during each visit including Janell Cannon’s *Stellaluna*, the print counterpart to the electronic storybook. The researcher eventually shared the *Stellaluna* CD-ROM storybook large screen with the group during a circle time meeting to role-model electronic storybook conventions and to demonstrate for the children the possibilities available when they would use the storybooks independently on classroom computers. After this group sharing the *Stellaluna* CD-ROM storybook was loaded on all four classroom computers for independent free choice use by the students. The students were excited about this new acquisition and used and read *Stellaluna* voraciously! Of note, before this time, among other classroom software holdings, only one other CD-ROM storybook was available on the classroom computers.

After two weeks of classroom observation and participation, the researcher spent the following two weeks observing four selected students using the *Stellaluna* CD-ROM storybook individually for 30 minutes each. Only one, rather than the originally planned two distinct observations, were completed due to the research time span shortened from six to four weeks. The original plan was for these observations to occur in their classroom at the early childhood center while fellow classmates were involved in rotating through other regularly scheduled activity centers within the classroom. Due to technological difficulties on the designated computers, the observations instead occurred in an alternative location within the early childhood center. During these 30 minute sessions, students were asked to read/interact with the “Play With Me” version of the
"Stellaluna" (Random-House-Broderbund, c. 1996) CD-ROM storybook on their computer workstation.

At these sessions, the researcher recorded student interactions with the CD-ROM storybook on a rubric via tally marks according to the frequency of response in five categorical areas, attentive/perceptual, affective, cognitive, CD procedures and metacognitive (Appendix). Each interaction that fell within one of these five categories was recorded in the appropriate category of the scale by the researcher. Numbers of interactions were tallied for each of these five categories for each child and these frequency numbers served to create a specific level of interaction score within each category. These levels of interaction scores for the individual cognitive and metacognitive categories were correlated with the spatial and intelligence strength scores of the student from the MIDAS/My Young Child profiles to determine what relationships may exist between the spatial and kinesthetic intelligence strength variables and the individual cognitive and metacognitive levels of interaction with the CD-ROM storybook variables.

Within the MIDAS/My Young Child assessment profile, in addition to scores for the spatial and kinesthetic intelligence strengths, scores were also provided for the Interpersonal, intrapersonal, kinesthetic, linguistic, math-logic, musical, naturalist and spatial intelligence strengths as defined by Howard Gardner (1999). In addition to scores, parents and the researcher also received a profile for the individual child that ranked their intelligence profiles generally from areas of current highest strengths to lowest weaknesses, broke the different intelligences down into specific skills and the categories
within which they fit and ranked each child accordingly from areas of highest to lowest strength and also broke the different intelligences down into subscale components such as physicality and dexterity for kinesthetic intelligence and artistic and constructions for spatial intelligence.

The researcher found that all of the quantitative data sets held promise for future and more in-depth analysis that would allow investigation of the separate and distinct pieces of information gleaned within this research study and also held potential for additional analyses outside the scope of this pilot study. Additionally, rich qualitative data not originally a part of the research design was gathered within the context of the individual observations and its apparent value in interpreting the results showed the validity of both considering and pursuing a mixed-methods study design in future iterations of this research. Each student appeared to enjoy the interaction with the CD-ROM storybook but approached the *Stellaluna* CD-ROM viewing/reading experience very differently.

There were four original research hypotheses which speculated that (1) there is a linear relationship between the child’s cognitive level of interaction with the CD-ROM storybook and the strength of their kinesthetic intelligence, (2) there is a linear relationship between the child’s cognitive level of interaction with the CD-ROM storybook and the strength of their spatial intelligence, (3) there is a linear relationship between the child’s metacognitive level of interaction with the CD-ROM storybook and the strength of their kinesthetic intelligence and (4) that there is a linear relationship between the child’s metacognitive level of interaction with the CD-ROM storybook and
the strength of their spatial intelligence. Inherent within the study was the expectation that children who possess spatial and/or kinesthetic intelligence strengths to a greater measure will interact with the CD-ROM storybooks more frequently and on a higher cognitive and metacognitive level. The combination of visual and verbal representation of content in the CD-ROM storybooks may have the capability to enhance the cognitive and metacognitive response of students possessing spatial intelligence strengths and the interactive hands-on capabilities of CD-ROM storybooks may have the potential to enhance the cognitive and metacognitive response of students with kinesthetic intelligence strengths.

Correlational analyses showed both hypotheses two and three to be supported. A very high positive linear relationship was found between the metacognitive level of interaction score and the spatial intelligence score and a high positive linear relationship was found between the cognitive level of interaction score and the kinesthetic intelligence strength score. Hypotheses one and four were not as well founded within this research study as little if any linear correlational relationship was found between the metacognitive level of interaction score and the kinesthetic intelligence score and a low negative linear relationship was found between the cognitive level of interaction score and the spatial intelligence score.

From the results of this pilot study there appears to be evidence that positive as well as negative relationships may exist between differing intelligence strengths and a child’s level of interaction with CD-ROM storybooks to some measure. Though this was a limited study that looked only at the potential relationships that may exist between
cognitive and metacognitive levels of interaction and kinesthetic and spatial intelligence strengths, the fact that strong positive linear relationships existed for two of the four hypotheses posited could indicate that there appears to be room for additional and more detailed study in this area and for the implications it may have for reading/literacy instructional strategies within the early childhood classroom.

There also existed strong qualitative evidence of differences in how children explored and interacted with CD-ROM storybooks. The spirit of these differences is captured by Turbill (2001) as she cites Parkes (2000) in noting that beginning readers use the illustrations to make meaning from books before they engage in the print. . . [and realized] that the children in [her] study were using visual animations in similar ways. Their ‘reading’ of the visuals and their discussions around these may have been different from what [one] might expect of book-based ‘reading’ of the illustrations, but the children were creating meaning from these visuals and animations. This form of ‘reading’ need[s] to be incorporated into both the teacher’s definition of reading and her classroom practice. (p. 275)

Though qualitative data was touched upon briefly and quite informally within this study’s context, the researcher found that the inclusion of qualitative data warranted further investigation and more detailed considerations and integration within future iterations of this study. This determination led to explorations into mixed-methods research designs and the decision to craft, within this context, a triangulation design that formally and concurrently integrates both quantitative and qualitative methodologies to create a more
complete view of research results. Lessons learned within this pilot process will be integrated and adapted into the formal dissertation research which is anticipated to occur in 2007.

**Timeframe and Procedure**

This study took place during March-May 2007 and continued for approximately eight weeks. In one of the classrooms, entry was gained via a second contact with a professional colleague who is an Administrator at the school to ascertain what additional and appropriate school system contacts should be made prior to the actual research. Initial contact was made earlier in 2006 as the researcher discussed the generalities of the pilot study and the Administrator colleague expressed interest in having the Kindergartners in her technology-rich school participate within the dissertation research context. Entry was gained in the second classroom via contacts with the Center Director and classroom teacher with whom the researcher previously collaborated during a Fall 2005 pilot study within their Center.

The researcher met with the Administrator, Director and teachers at both locations and provided them with letters to distribute to the students’ parents within which the research process was explained fully. Parents were also given information on the use and administration of the MIDAS-KIDS/My Young Child instrument (Shearer, c. 1994-2002). Parents were asked to complete the instrument by responding to the instrument questions directly according to their beliefs of their child’s abilities for each of the questions and return these results to the teacher within one week. The researcher acquired the completed instruments and assessment results were scored not only by the instrument
creator, Dr. C. Branton Shearer, via scanned data sheets, but also scored manually by the researcher via data insertion into an online MIDAS assessment and administration tool.

Participant observation allowed the researcher to have immediate and personal involvement in the social world chosen to study; in this case a Kindergarten classroom. During the duration of the study, participation consisted of the researcher’s presence within the classrooms for portions of two days per week over eight weeks. Part of this time was used to become acquainted with the children, teachers and classroom practice as well as to gradually present to the children a sequential introduction to storybooks in electronic formats. The researcher shared print storybooks during each visit including Janell Cannon’s *Stellaluna*, the print counterpart to the electronic storybook. The researcher also eventually shared the *Stellaluna* CD-ROM storybook large screen with the group during a circle time meeting to role-model electronic storybook conventions and to demonstrate for the children the possibilities available when they would use the storybooks independently on classroom computers. After this group sharing the *Stellaluna* CD-ROM storybook was loaded on all classroom computers for independent free choice use by the students.

After two weeks of classroom observation and participation, the researcher spent the following six weeks observing sixteen randomly selected students in each classroom using the *Stellaluna* CD-ROM storybook individually for 30 minutes each. During these 30 minute sessions, students were asked to read/interact with the “Play With Me” version of the *Stellaluna* (Random-House-Broderbund, c. 1996) CD-ROM storybook on their
computer workstation. Each of these individual sessions were videotaped from the rear to document interactions on screen.

Data gathered during these observations was correlated with data from the MIDAS-My Young Child instruments completed by the parents. Analysis of both the quantitative correlation results and the qualitative observational data was conducted with data gathered triangulated and analyzed as a singular informational set.

As a central focus of the case study design, exemplar cases for extended study and analysis occurred via the selection of two students possessing spatial and kinesthetic intelligence scores falling in the very high range as well as two students possessing spatial and kinesthetic intelligence scores falling in the very low range on their MIDAS/My Young Child profiles. These student exemplar cases were further analyzed in triangulation with their descriptive qualitative data to determine if patterns emerged that might provide evidence for support of hypothetical stances within the study that theorize the existence of stronger more positive relationships between spatial and kinesthetic intelligences individually and the respective student combined cognitive and metacognitive interactions with a CD-ROM storybook.

**Summary**

In summary, this mixed-methods study looked at the potential relationship that may exist between students’ eight individual intelligence strengths and their combined cognitive and metacognitive levels of interaction with a CD-ROM storybook. The eight multiple intelligence strengths of a sample of thirty Kindergarten students, measured via the MIDAS/My Young Child (Shearer, 1994-2002) instrument was correlated with their
levels of interaction with a CD-ROM storybook as measured by the researcher’s adaptation of a rubric used by Labbo and Kuhn (2000). Additionally, qualitative data gathered through the individual observations was triangulated during data analysis to create a more complete view of research results. Four exemplar cases of students representing very high and very low spatial and kinesthetic intelligence scores was analyzed more closely with both quantitative and qualitative data triangulated to determine if any distinct relationship patterns emerge.

It was hypothesized that this triangulated data analysis would show different measures of both qualitative and quantitative relationship between spatial, kinesthetic, interpersonal, intrapersonal, linguistic, logical-mathematical, musical and naturalistic intelligence strengths individually and the participants’ combined cognitive and metacognitive levels of interaction with the CD-ROM storybook. It was further hypothesized that selective case study analysis of exemplar cases would show emergent patterns that demonstrate the likelihood of a stronger positive relationship for students with very high spatial and kinesthetic intelligence strengths individually and their combined cognitive and metacognitive levels of interaction with the CD-ROM storybook.
CHAPTER IV
ANALYSIS OF THE FINDINGS

Introduction

The purpose of this study was to investigate potential relationships between students’ levels of interactions with CD-ROM storybooks and their individual multiple intelligence strengths. Learning more about how young children interact with electronic CD-ROM storybooks within the lens of multiple intelligence theory holds great potential for maximizing reading instruction for the individual child. This study is one empirical piece within a growing and continually evolving research puzzle.

There are two broad research questions addressed simultaneously throughout the study.

1. What is the relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their eight individual multiple intelligence strengths?

2. What apparent observed meaning making, from both the participant and researcher perspectives, is occurring within select participants individually as they interact with an electronic CD-ROM storybook?

Firstly, this mixed-methods study looked at the potential relationship that may exist between students’ eight individual intelligence strengths and their combined cognitive and metacognitive level of interaction with an electronic CD-ROM storybook. Data analysis involved determining correlations between the eight multiple intelligence strengths of a sample of 32 Kindergarten students, measured via the MIDAS/My Young
Child (Shearer, 1994-2002) instrument and children’s levels of interaction with an electronic CD-ROM storybook as measured by the researcher’s adaptation of a rubric used by Labbo and Kuhn (2000). Additionally, to support the individual case analyses, qualitative data gathered through the individual observations was triangulated with the quantitative during data analysis to create a more complete view of research results.

The first question hypothesized that the quantitative data analysis could suggest different measures of relationship between the eight intelligence strengths individually and the participants’ combined cognitive and metacognitive levels of interaction with the electronic CD-ROM storybook. These cognitive and metacognitive interactions were differentiated through definitions and applications used by Labbo and Kuhn (2000) and from whom the researcher adapted the qualitative observational rubric. The combination of visual and verbal representation of content in the CD-ROM storybooks as well as their interactive hands-on capabilities may have the capability to enhance or detract from the cognitive and metacognitive response of students possessing specific intelligence strengths. As analysis progressed, these hypotheses appeared to vary individually and were supported in some instances to different measures and not at all in others.

Secondly, the individual case analyses selected were comprised of four exemplar cases of students with two representing very high and two representing very low spatial and kinesthetic intelligence strength scores. It was predicted that due to the combination of the verbal and visual components of CD-ROM storybooks, these elements would encourage and facilitate the combined cognitive and metacognitive level of interaction that children with high spatial abilities would have with the story on-screen. In addition,
it was also predicted that the interactivity of the CD-ROM storybooks might support children with higher kinesthetic intelligence strengths as they physically respond within the interactive tableau of stories in electronic format. It was additionally predicted that further analysis within a selective case study framework of exemplars, utilizing both qualitative and quantitative data gathered, would possibly detect and allow for further investigation of emergent patterns within individual student responses to the electronic CD-ROM storybook; ones that might demonstrate the existence of relationships between students’ possessing either very high or very low spatial and kinesthetic intelligence strengths individually in consort with their combined cognitive and metacognitive levels of interaction with the electronic CD-ROM storybook. If detected, these patterns might indicate that students at extreme ends of these continuua could hold some additional keys to understanding potential relationships that might exist between students’ spatial and kinesthetic intelligence strengths and their interactions with and responses to an electronic CD-ROM storybook. In retrospect, this analysis appeared to lack merit in the exemplar cases examined.

The Classrooms

The sample Kindergarten class research sites were selected based on the researcher’s original understanding of students’ access to and experience with computer technology within their respective classroom educational environments. This anticipated homogeneity in experience fell within random purposive selection parameters. This homogeneity did exist but the researcher also, once on site, found interesting examples of heterogeneity in classroom educational philosophy and practice. The first research site’s
classroom was located within a private Preschool-Kindergarten Center and was conducted within a Reggio Emilia frame of practice. The remaining two classrooms were located within a Grade Kindergarten – 6 public school and were managed within a traditional drill and practice classroom model. As the researcher began data analysis, there developed interesting trends among the data displays which hinted that these differences in classroom philosophy and practice could have had an effect upon the correlation results. This development will be discussed in more detail within the conclusions and implications of the study.

**Interview Data**

One of the important criteria used in selecting classrooms for this study was the availability of and student access to, and facility and comfort with, computer technology within the Kindergarten classrooms. It was perceived that structured interviews with the classroom teachers concerning their feelings about and philosophies concerning the use of computer technology within their classrooms would provide an informative context for the study and its results. Each teacher was interviewed using a thirteen question structured protocol (Appendix).

**Meredith**

Meredith was the teacher for group 1 and had a similar longevity of classroom experience to that of Jennifer, the second teacher whose classrooms were observed. Her instructional style was one in alignment with a Reggio Emilia frame of practice. Meredith had used computer technology within her classroom for 10 of her classroom years, with grant monies facilitating the acquisition of both hardware and software for her
classroom. In addition, she was able to partner with a local university and its educational technology classroom facility in order to enhance her students’ experience with and access to technology applications within her classroom.

Meredith’s physical classroom space was large and expansive and offered many opportunities for free play and exploration. Child appropriate tables and chairs encouraged collaboration and sharing, whether of classroom activities and assignments or lunchtime choices and conversations. The room was literacy and student-focused in both its activities and physical features. When students signed in in the morning they were asked to ‘write’ a sentence about a whiteboard announced topic of the day. There was also a ‘writer’s space’ provided with paper, scissors and writing instruments of various sorts, where students could create and record their thoughts. One side of the room acted as a ‘word wall’ where students interacted with a combination of basic sight words, names of individuals in the classroom as well as words encountered within their daily activities, and all organized by letter of the alphabet. This was a free choice activity scheduled within their day but the mere square footage of space it encompassed made its physical presence was an imposing one.

There was also a carpeted Circle Time space where the class gathered as a group at the beginning and end of the day as well as during the course of the day for special storytimes and collaborative story creation with their teacher. The classroom offered immediate access to an outside play and discovery space, which served both as a natural classroom extension space for fun as well as for continued exploration of scientific, mathematical and other concepts introduced within classroom formal and informal
discussions. Students often documented their learning through use of a simple digital camera. Their photographs were then integrated within the collaborative story of daily activities shared within their closing Circle Time.

There were spaces for artistic exploration close to a child appropriate sink/cleaning facility. Nearby was also a classroom-access restroom. There was not a teacher desk within the classroom proper but in a small anteroom/office adjacent to the classroom. Next to this office space was also a small room which shared both art supplies and also within which was a computer which served as the spot for subsequent researcher observations of student interactions with the CD-ROM storybook. Last, but certainly not least, there was a computer space where students could choose to interact with software of choice loaded on the desktop or from a cart where teachers or aides could load specific pieces on student demand. There were four computers in this space and a bench hosting two students per computer, encouraging a social usage and interaction with the computer technology.

Meredith saw computer technology as a ‘piece of the puzzle’ . . . a tool or vehicle to facilitate student learning. She saw it as a means to differentiate instruction and help the kids ‘where they are’ . . . at the natural variance of levels that can exist within a kindergarten classroom. For the bright students, Meredith saw computer technology as a tool to challenge their learning; for those who were struggling, she saw computer technology providing a different style in content delivery and one that could make the learning easier for those children.
Specifically, Meredith saw the computer as a helpful tool within literacy instruction in that it provided a variety of outlets for student involvement in their own learning and also as a boon in the learning itself. She saw computer technology as ‘pushing kids to develop literacy more quickly” and for some, a motivational reason to learn more quickly. Meredith looked at the computer as a communication device and made use of this concept with her students in a variety of ways. Students had e-mail accounts with family members e-mailing both to students and students to each other. She made use of portable Alphasmart keyboards which could travel home with students, allowing them to dictate stories and interview family members about classroom specifics which could then be reported back within classroom conversations. The keyboards, whether by means of the Alphasmart or classroom computers, facilitated letter recognition and Meredith saw the use of Microsoft Word within her classroom as “literacy in disguise”. As appropriate, Meredith also used various guided webquests with her students.

Similar to that of Jennifer, Meredith’s use of computers within her classroom included integrated as well as point of need opportunities, but her use appeared more holistic and student-driven. Computers were used as free choice options for students but also as tools for specific content learning. Specific technology learning tools such as the Intel microscopes and cameras were connected to classroom computers when needed. The software selected included those titles which were user friendly and engaging and, at the same time, open-ended. Specific software mentioned included storybooks, Kidpix, Paint, Super-Duper Music, Neighborhood Map Machine, Golly Gee Blocks, Diorama
Designer, Where Are We? and Dorling Kindersley’s Human Body. In addition to this software, Meredith also used some educational websites as classroom support. These included NASA Kids (http://www.nasa.gov/audience/forstudents/k-4/index.html), various zoo and math sites, PBS Kids (www.pbskids.org) and a specific one to integrate with a unit on the Snowflake Bentley print storybook.

Meredith’s strategic classroom integration of computer technology to assist her with meeting the demands of the Ohio Academic Content Standards was one which she labeled ‘backmapping’. She knew where students needed to be by the end of the school year, and with that awareness, and working backwards through the school year, would be able to pinpoint the various academic content standards within their daily and monthly curricular foci. Once this was in place, it was easier for Meredith to identify various opportunities where the computer would be a tool in the particular learning opportunities which would arise.

Meredith cited her greatest professional supports as those including her relationship with the local university educational technology staff and the learning opportunities their educational technology classroom provided. She developed a strong working relationship with the staff there and a dual flow of information on technology usage within the classroom was ongoing.

Her final thoughts focused on views of the positives and negatives that computer technology presented both with her classroom instruction and for her students. The negatives were very surface level and uni-dimensional in that they focused on the lack of
immediate technology support for her classroom when hardware or software isn’t working as planned. The positives, however, were pervasive.

Meredith saw the motivational benefits of computer technology in that her kids were “always excited . . . to them it’s a cool way to learn . . . (they) think they’re playing, having a wonderful time.” She saw technology’s benefits for the development of fine motor skills in students’ use of the keyboard and the appearance on screen of what children input as a support for the visual/motor connection. This keyboard/screen connection was also something in which Meredith saw computer technology supporting transfer of knowledge. She also appreciated its support of social skill development as students learned how to take turns and work together.

Meredith noted that “literacy development takes off as they use technology” and students are able to see the results of their interaction with the keyboard/screen in personal communication and meaning-making. She also noted that her students who weren’t as verbal had an opportunity to shine as they became experts with the computer technology and supports for their more verbal classmates.

Meredith’s use of computer technology within her Kindergarten classroom encouraged the use of higher level thinking and supported her differentiated instructional strategies. The broad and varied uses of technology she employed maximized the benefits of the technology in accordance with her individual students’ needs, strengths and weaknesses.
Jennifer

Jennifer was the teacher for groups 2 and 3 and had over 30 combined years of classroom experience. It was not as easy to paint a picture of Jennifer’s thoughts and strategy as her interview data was more concrete and matter-of-fact in contrast to the conversational detail and increased depth of thought that was gleaned from the interview with Meredith.

Her instructional style was molded by her school district’s requirements and was categorized as a more traditional drill and practice classroom model. During shared private lunch sessions within her classroom, Jennifer confided in the researcher her sadness and concern about the instructional model adopted by her school district and whether it was effective in making students lifelong readers. She stated at one point that she knew by the test scores touted by her district that she was successful in teaching students how to read, but questioned whether she was successful in teaching them the love of reading.

Her classroom was a more traditionally structured Kindergarten space that supported the instructional model and philosophy within the school and the classroom. There was a space for a teacher’s desk within the classroom and this area was a hub of activity for students as they entered the classroom each day. It was a large space that hosted two classrooms, both a morning and an afternoon session. Students had private chairs and desks of a child-appropriate size. Signage and posters throughout the room supported literacy instruction as well as basic math concepts.
There was a child-appropriate sink and restroom with free access from the classroom and quiet space for student testing and skill drills adjacent to the classroom. Within their building, art and music were pull-out activities and there was not space allotted for these within the classroom. There were spaces for books and toys for free choice activities and student artwork proliferated throughout the room.

A welcoming carpeted space was designated for Circle Time which included a rocking chair for teacher/guest use for group led activities and storytelling. This was the place for both stories and reading! Reading instruction centered here and small groups came to read orally with Jennifer, in a sing-song fashion kept in alignment via Jennifer’s measurement of student reading pace through the soft patting on her leg of a wooden stick.

The Circle Time space bordered a computer space where students had access to several age-appropriate computer programs loaded on the desktop or on a cart nearby for adult loading into the hard drive. There were two computers on child-size tables and a traditional child’s chair for each. Though children were welcome to share their computer experience with others, the furnishing did not encourage their doing so. The computer space was a free choice activity and not specifically integrated within classroom instruction that was observed by the researcher.

Jennifer had used computer technology within her classroom for the latter 15 years of her teaching experience, beginning this use with the novelty of computer games when few children in her class had access to computers in their homes. She saw computer technology as a tool or vehicle to be used within the teaching of curriculum
standards as well as to facilitate her students’ basic computer literacy. In addition, she saw the computer as a helpful tool within literacy instruction in that it provided not only an outlet for student involvement in their learning but as a boon in the learning itself. She also saw the computer as an opportunity for individualized instruction in its ability to meet student needs in a very specific way based on the student. Some needed additional time learning via this medium where other students appeared to be saturated or ‘glued’ to the computer and needed other more traditional opportunities to engage them in their learning.

Her use of computers within her classroom included integrated as well as point of need opportunities. Computers were used within learning centers and for tutoring students in specific aspects of the Kindergarten curriculum. Jennifer did not have classroom aides or additional hands for assisting students, so computer use and application depended entirely upon her as an individual. She made a strong effort to keep technology central in her classroom and to keep up to date in the software as well as web based options that would help her students to become more successful in their learning.

The software selected for student use included those titles which were user friendly and engaging and, at the same time, in support of curriculum standards. Specific software mentioned included various storybooks, Dorling Kindersley skills practice pieces and Reader Rabbit. In addition to this software, Jennifer also used some educational websites as classroom support. These included Scholastic (www.scholastic.com), Starfall (www.starfall.com) with their wonderful interactive and
age appropriate variety of online storybooks and The Weather Channel (www.weather.com).

Jennifer’s strategic classroom integration of computer technology to assist her with meeting the demands of the Ohio Academic Content Standards was one which began with the specific instructional standards and her search for the technology to assist her in meeting these instructional goals for her students. As cited above, within this search, she made many successful selections that included both stand-alone software packages as well as web based resources. She cited her greatest professional supports as those including her on-call, on-site school district’s Information Technology staff as well as her self-generated professional development as she sought out and registered for additional university classwork to upgrade her specific computer technology skills.

Her final thoughts concerned her vigilance and awareness of which of her students were using the computers in her classroom centers. She saw the merit in the technology’s support of her students’ review of skills and partnership work but at the same time was also attuned to the fact that students needed balance with the various tools that her classroom provided in accordance with their individual student needs, strengths and weaknesses.

Classroom philosophical differences and mandates within instruction were evident in the researcher’s observations of the technology usage within the classrooms of Jennifer and Meredith. Technology was freely available to the students and its usage was supported, but this usage was necessarily bathed within the differences present and found
in a traditional versus Reggio Emilia classroom models. Though not better or worse, they were different and this difference was a tangible presence for the researcher.

**Discussion of Findings**

The virtues of a mixed methods study allows for the mix of triangulated data to inform study results demonstrating both points of agreement and dissimilarity and allows the opportunity for explanation in more depth of what was occurring within the research environment. Correlational analyses did not demonstrate strong linear relationships between student kinesthetic and spatial intelligence strengths and the combined cognitive and metacognitive interactions with the CD-ROM storybook. Even so, individual looks at student exemplars seem to depict their own unique and different stories. Each student appeared to enjoy the interaction with the electronic CD-ROM storybook but approached the *Stellaluna* CD-ROM viewing/reading experience very differently.

As a central focus of the case study design, exemplar cases for extended study and analysis occurred via the selection of two students possessing spatial and kinesthetic intelligence scores falling in the very high range as well as two students possessing spatial and kinesthetic intelligence scores falling in the very low range on their MIDAS/My Young Child (Shearer, 1994; 2002) profiles. Timed observations of the four student exemplars produced scores for the combined levels of cognitive and metacognitive interactions that appeared to demonstrate some emergent patterns of relationship to specific intelligence strengths within student responses to the CDROM storybook. Rich qualitative data was gathered within the context of the individual observations through the use of the Level of Interaction rubric (Labbo & Kuhn, 2000) for
the four exemplar students. All student exemplar cases were further analyzed in triangulation with their descriptive qualitative data to investigate and evaluate individual meaning making to determine if any additional patterns emerged. If so, these might provide evidence for support of hypothetical stances within the study that theorize the potential for the existence of stronger more positive relationships between spatial and kinesthetic intelligences individually and the respective student’s combined cognitive and metacognitive interactions with an electronic CD-ROM storybook. Each of these student exemplar cases will be discussed more thoroughly and individually within the qualitative data analysis.

**Descriptive Data**

Descriptive statistics, as depicted in Tables 1-3 provide an overview of classroom participant data. Table 2 shares data for each of the sample students in the three classrooms in relation to their Level of Interaction Rubric data, Table 3 shares data for each of the sample students in the three classrooms in relation to their MIDAS/My Young Child eight intelligence strengths/profile and Table 4 shares strengths and weaknesses in relation to Gardner’s (1983) eight intelligence strengths; highest (maximum) and lowest (minimum) scores as well as the mean score for each intelligence is represented therein. The total combined cognitive and metacognitive interactions with the electronic CD-ROM storybook in the combined classrooms showed an individual maximum of 301 interactions and a minimum of 12 individual interactions with a mean of 116.09.
Table 1

*Participant Observation/Level of Interaction Rubric Data Key*

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
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<tr>
<td>C.T.</td>
<td>Combined Total of Cognitive and Metacognitive Interactions</td>
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<td>Cog</td>
<td>Cognitive Interaction Total</td>
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<td>Met</td>
<td>Metacognitive Interaction Total</td>
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<td>L</td>
<td>Labeling</td>
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<tr>
<td>P</td>
<td>Predicting</td>
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<tr>
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<td>Describing Action</td>
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<tr>
<td>C</td>
<td>Confirming</td>
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<tr>
<td>W</td>
<td>Wondering</td>
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<tr>
<td>IC</td>
<td>Intratextual Connections</td>
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<tr>
<td>S</td>
<td>Providing Summary Statement</td>
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<tr>
<td>PLC</td>
<td>Personal Life Connections</td>
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<tr>
<td>CC</td>
<td>Commenting on Character</td>
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<tr>
<td>ME</td>
<td>Strategic Access of Media Effects</td>
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<tr>
<td>PC</td>
<td>Commenting on Plot</td>
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<tr>
<td>O</td>
<td>Parallel Story Oval Connection</td>
</tr>
<tr>
<td>TC</td>
<td>Commenting on Theme</td>
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</table>

Within a total possible score of 100%, these descriptive scores reflect the range of student strengths and weaknesses as represented across the classroom sample membership. The spatial and kinesthetic held the two maximum intelligence scores across the sample while the linguistic and math-logical held the two minimum scores across the sample. These strengths are in agreement with the findings of Teele (2004) whose analysis of over 6000 student profiles resulting from her Teele Inventory for Multiple Intelligences (1992) has shown a trend that indicates certain intelligences tend to be dominant within certain grade levels with Kindergarten students’ top two dominant intelligences being the spatial and kinesthetic.
Table 2

Participant Observation/Level of Interaction Rubric Data

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Table 4

Multiple Intelligence Sample Maximum Minimum Mean Scores

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Correlational Relationships

Table 5 illustrates the results of using the Spearman rho correlational statistic to determine the eight individual intelligence strength linear correlation and two-tailed significance values for the student sample in comparison with their total combined cognitive and metacognitive electronic CD-ROM storybook interactions. Significant scores are bolded within the table.

Table 5

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<td>.128</td>
<td>.379</td>
<td>.132</td>
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<tr>
<td>Linear Two Tailed Significance</td>
<td>.106</td>
<td>.014</td>
<td>.246</td>
<td>.438</td>
<td>.083</td>
<td>.436</td>
<td>.017</td>
<td>.423</td>
</tr>
</tbody>
</table>

(.05 Significance Level)
When looking at the correlational data for the eight intelligence strengths, significant, though low positive, linear relationships were found for both the intrapersonal and naturalist intelligences. Each of these intelligence scores were comprised of various subscale data which further break down and define different areas of strengths within each. Looking at this subscale data assisted the researcher in finding possible explanations for the linear relationships that became apparent (Table 6).

Table 6

*Multiple Intelligence Strengths of Student Exemplars*

<table>
<thead>
<tr>
<th>Multiple Intelligence Strengths</th>
<th>Interpersonal</th>
<th>Intrapersonal</th>
<th>Kinesthetic</th>
<th>Linguistic</th>
<th>Math-Logical</th>
<th>Musical</th>
<th>Naturalist</th>
<th>Spatial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethan</td>
<td>23%</td>
<td>21%</td>
<td><strong>27%</strong></td>
<td>34%</td>
<td>35%</td>
<td>28%</td>
<td>36%</td>
<td><strong>31%</strong></td>
</tr>
<tr>
<td>Garrett</td>
<td>64%</td>
<td>83%</td>
<td><strong>61%</strong></td>
<td>79%</td>
<td>62%</td>
<td>63%</td>
<td>75%</td>
<td><strong>88%</strong></td>
</tr>
<tr>
<td>Kenyon</td>
<td>41%</td>
<td>50%</td>
<td><strong>61%</strong></td>
<td>27%</td>
<td>35%</td>
<td>60%</td>
<td>80%</td>
<td><strong>35%</strong></td>
</tr>
<tr>
<td>Tressa</td>
<td>61%</td>
<td>75%</td>
<td><strong>68%</strong></td>
<td>75%</td>
<td>81%</td>
<td>45%</td>
<td>84%</td>
<td><strong>92%</strong></td>
</tr>
</tbody>
</table>

There were indeed linear relationships, to some measure, in place for this sample of Kindergarten students. It became potentially more informative and intriguing, however, as the triangulated data for the four student exemplars came into view, both individually as well as in their cross case analysis. It was at this point that possible explanations became more evident and plausible. These explanations possess a potential relationship to the concept of examining individual student profiles and how such impacts both group and individual student experiences, and conversely, student levels of interaction with
CD-ROM storybooks in relation to their personal multiple intelligence strength individual profiles.

As Gardner (1983) has espoused in his theory of multiple intelligences, each of us has a measure of all of the intelligences and it is this combination of such that make us all uniquely talented as individuals. In looking more closely at the four student exemplar intelligence profiles, these indicate their particular personal full scale as well as their subscale intelligence strengths for each of the eight intelligences. It appeared that the interplay not only of the total individual but also of the separate strengths and subscale strengths within each student, as opposed to an isolation of particular individual strengths’ analysis which the researcher brought forth, assisted in the creation of a fuller picture of what was at play between the students’ levels of combined cognitive and metacognitive interactions with the Stellaluna CD-ROM storybook.

These findings suggest that there are indeed some individual intelligence strength relationships among the student sample with statistical significance. A few of these, the intrapersonal and naturalist strengths, demonstrated linear correlational trends. Even greater, and of more importance to the study overall, however, was the appearance that though these individual strength trends were apparent across the sample, it was in looking at how these individual strengths created a package of a unique student intelligence profile that was of potentially more lasting and significant importance. This was demonstrated across each of the exemplar students examined within the case study analysis.
Could it be that student strengths and weaknesses in certain areas were buoyed by their individual personal intelligence profiles as a whole? It is now to that exemplar student case study analysis that we turn.

**Exemplar Students Case Study Results**

In this section will be an individual reporting of each exemplar student observational data in relation to their combined cognitive/metacognitive interactions with the *Stellaluna* CD-ROM storybook. These four student exemplars were chosen based on their individual multiple intelligence strength scores that represented very high and very low spatial and kinesthetic intelligence strengths. These particular strength scores were identified as potentially noteworthy and impactful first due to predictions that the combination of the verbal and visual components of CD-ROM storybooks, and these associated elements, might encourage, facilitate and enhance the combined cognitive and metacognitive level of interaction that children with high spatial abilities would have with the story on-screen. In addition, secondly, it was also predicted that the interactivity of the CD-ROM storybooks might support children with higher kinesthetic intelligence strengths as they physically responded within the interactive tableau of stories in electronic format.

In setting the stage for these observations, the researcher attempted to find a location within both research settings where student distractions would be minimal and where the researcher and student could proceed without interruptions for the thirty minute CD-ROM storybook observation. Neither the teacher nor other classroom students were present for these observations. It was also important to find a location within which the
student was both comfortable and familiar. It goes without saying that these observational settings required at least one computer with an operational CD-ROM drive. These locations also needed to provide access to sufficient space for mounting the camera for the on-screen recordings of student activities. A location with these requirements was found in both locations.

During the observations, the student and researcher were both seated in chairs side by side and table/counter space nearby, within vision and access range of the student, offered the opportunity for the researcher to display both the Stellaluna storybook as well as the Stellaluna DVD and CD-ROM cases. These displays were to offer opportunities for individual students to potentially bring other Stellaluna formats into both their personal viewing and interactions with the Stellaluna CD-ROM storybook. Observation times were monitored via the researcher’s wrist watch.

Garrett

Garrett was a bright, happy and genuinely ebullient child. With dark hair, sparkling blue eyes and a quick smile, he looked to the caring adults around him for encouragement and support. He interacted easily with both boys and girls within his classroom and was sought out for play. He possessed successful social classroom skills and was appropriately verbal, seeking accepted times for classroom participation.

Of the four exemplar children observed and as demonstrated in a representation of their multiple intelligence strengths found in Table 6, Garrett ranked first in combined cognitive and metacognitive level of interaction and second in intrapersonal, kinesthetic and spatial intelligence scores. Our time together during the observation was a
pleasurable and very rich experience, peppered with conversation throughout. He was quite conversant with the story, anticipating actions and events in the story grammar based on previous experiences and time spent enjoying and interacting with the story. He considered the researcher as a co-participant in the story experience, with a steady interaction and conversational repartee between story choice and experience and the researcher’s reaction to and opinion of such. He demonstrated a consistent and exceptional engagement with the story. He used the term ‘love’ prolifically as he interacted with Stellaluna, beginning with the statement “I love Stellaluna!” before we even started the storybook.

It became very evident that he had a plan on how to progress through the story. As he was preparing to move on to page 2, he hesitated and said “Wait!”, and returned to view the storm hot spot, declaring “I like this one!” As he viewed the spider appear on page 2, he exclaimed “I like this!” and then planned and consequently executed his interactive movement throughout spider’s tableau. On page 7 he commented that “most of the funny things are here”. When nearing completion and deciding on the next action phase he stated, “(that’s) pretty much everything on this page!” He continued these statements for the next few pages after clicking his last object on the page by declaring “That’s pretty much it” or similarly, “that’s it on this page”. It became apparent that Garrett had a certain agenda to complete on each of the pages, based on past experience, planning and concrete decision making. His was not a random viewing or clicking interactivity, but an approach and process that was metacognitively measured.
Garrett used his previous interactions and experiences with *Stellaluna* within the classroom to guide his actions and pathways throughout. His use of language was full and expressive. One instance of this occurred on page 6, as he refers to the blue colors present as “beautiful shades.” His predictive skills were prolific as he talked throughout about anticipated objects and actions. On page 5 he noted, “I think that caterpillar is here” as he explored the page looking for objects seen in previous uses of Stellaluna.

Garrett also possessed great skills of observation and developed reasonably logical explanations for what he saw occurring on the page. One example of this is when he commented on page 6 as ladybugs pepper the screen, “the ladybug has babies”. He was the only child observed who noticed on page 5 that Stellaluna’s mother was flying by the moon. He returned to view the oval, which displayed the parallel story of Stellaluna’s mother’s escape and search for her child, a total of seven times, commenting during a few of those viewings, “What’s happening to mama?”. He didn’t click on this parallel story lens randomly but was quite aware of the oval’s purpose and that there was another story going on behind the scenes. His interaction was full and emotionally laden with visual demonstrations such as “this is my favorite part!” as he physically clutched his hands together with evident glee. His use of language remained full as he commented on the blue butterflies and that they were “so beautiful!” He looked to the researcher as a co-participant, and even co-reveler, in the story experience and made regular glances in the researcher’s direction and comments to her concerning particularly enjoyable episodes and events. His detailed observations continued as he noticed the yellow butterfly’s appearance on page 2 and comments “this is where she begins”. He notes her
appearance again on multiple pages with exclamations of “there she is!” and indicating her presence physically on screen with either a finger or with the mouse cursor. He eventually pulls together an imagined relationship between Stellaluna and the butterfly as he comments on page 7, “she really is friends!” as he connects the personages of the butterfly and Stellaluna.

Garrett’s metacognition – his thinking about his thinking - was evident not only qualitatively but quantitatively. His total metacognitive level of interaction numbered 202, with several instances of predicting and confirming behaviors and numerous instances of strategic access of media effects, as reported in Table 7. Individual student combined cognitive and metacognitive interactions were measured via the researcher’s adaptation of an observational rubric developed by Labbo and Kuhn (2000). Within this rubric, metacognitive behaviors were defined as predicting, confirming, intratextual connections, personal life connections, strategic access of media effects and misconceptions. He also made occasional intratextual connections between events in the story as a whole and also personal life connections with one example occurring when

<table>
<thead>
<tr>
<th>Metacognitive Interactions</th>
<th>Total</th>
<th>Predicting</th>
<th>Confirming</th>
<th>Media Effects</th>
<th>Intratexual</th>
<th>Personal Life</th>
<th>Misconceptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethan</td>
<td>127</td>
<td>28</td>
<td>16</td>
<td>61</td>
<td>7</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Garrett</td>
<td>202</td>
<td>37</td>
<td>34</td>
<td>126</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Kenyon</td>
<td>97</td>
<td>7</td>
<td>6</td>
<td>77</td>
<td>6</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Tressa</td>
<td>90</td>
<td>15</td>
<td>10</td>
<td>46</td>
<td>7</td>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>
Stellaluna ate the grasshoppers and showed her obvious distaste. Garrett agreed and said “I don’t like those either”.

Garrett’s 99 cognitive interactions with Stellaluna were active as well. Cognitive behaviors were defined as labeling, description of action, wondering, summary statement provision, character commentary, plot commentary and theme commentary. Garrett provided summary statements about on screen events, labeled objects and actions on screen as well as engaging in plot commentary. Specific frequencies of these activities can be found within Table 8. He commented once again on not wanting to eat grasshoppers, in sympathy with Stellaluna, and also echoed the mother bird from personal experiences as he proclaimed “get up there this instant!” One example of these interactions occurred when Stellaluna and the birds were talking about their house and Garrett commented “it’s not a house, it’s a nest!” It gave the researcher an opportunity to talk with him about nests being houses for birds. Another instance occurred when the birds called Stellaluna by her name and he wondered “How did they know her name?”

Table 8

*Cognitive Interactions with Storybooks*

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethan</td>
<td>55</td>
<td>10</td>
<td>0</td>
<td>15</td>
<td>11</td>
<td>4</td>
<td>0</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Garrett</td>
<td>99</td>
<td>32</td>
<td>0</td>
<td>8</td>
<td>26</td>
<td>6</td>
<td>0</td>
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<tr>
<td>Kenyon</td>
<td>43</td>
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<td>8</td>
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<td>12</td>
<td>4</td>
<td>0</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>
Garrett also actively wondered about the occurrences on screen. In looking at a knothole in a tree and some eyes peering out on page 6, he wondered whether there was an owl living in the tree or maybe a raccoon? His guesses and assumptions were true to his personal life connections and what he knew of the world.

He made consistent comments about story events and characters, such as his expression of delight in the descending spider on page 2 . . . ”I like that one!”, he liked the ladybugs following each other on page 3, he ‘loved’ the monkey on page 4, ‘loved’ the birds colliding with each other on page 4, ‘loves’ the song on page 4, ‘loves’ Stellaluna on the branch on page 5, ‘liked’ the worm on page 5 and ‘loved’ the blue butterflies on page 6.

Here it appears that the combination of verbal and visual representations of content and the interactive hands-on capabilities are enhancing Garrett’s response to the CD-ROM storybook. He made frequent predictions and confirmations of actions to come and also made noteworthy personal life connections. Would this level of interaction be the same with the print storybook? In comparing the print and CD-ROM formats of Stellaluna, the contextual detail and level of personal choice provided within the CD-ROM storybook provides a strong incentive towards freedom of exploration and a deeper investigation of the story and all that it holds. It is almost as if a portal is opened within the story and beckons for the student to enter deeper within. Garrett took a full advantage of this portal to freely explore and investigate as evidenced by his elevated level of interactions within this CD-ROM storybook. He was empowered through these representations and enhanced capabilities to engage in a very personalized level of story
creation and in-depth interaction through the pathways he chose and the interactions he took advantage of and pursued.

In looking at details of his MIDAS/My Young Child intelligence profile, as provided for all exemplars in Table 6, Garrett scored very high in spatial and high in kinesthetic strengths; they were his first and eighth highest strengths in his personal profile. Garrett also scored very high in intrapersonal, with this his second highest personal intelligence score.

MIDAS/My Young Child intelligence subscale scores, as illustrated in Tables 9-12, are provided not only for Garrett but for all student exemplars, and offer additional data of interest for analysis. In the kinesthetic subscales he scored very high in dexterity and, in the spatial subscales, he scored very high in the artistic and constructions subscales, as well. In the intrapersonal, Garrett scored very high in the self-management and goal achievement subscales. In combining the scores from both kinesthetic and spatial, he had the second highest combined score of all four exemplar children. His fourth highest personal intelligence score was the naturalist, and within such he scored very high in the science subscale.

Garrett’s combined cognitive and metacognitive interactions with the *Stellaluna* CD-ROM storybook were not only quantitatively highest but qualitatively high as well. It was evident that he was taking full and robust advantage of the opportunity to explore the different interactive pathways of the electronic narrative, delving deeper within the story present before him. He had an unspoken plan for his story exploration that not only
empowered him as a reader but allowed a deeper, richer experience of the interactive narrative elements at hand.

Table 9

*Intelligence Subscales: Spatial (S) and Math-Logical (ML)*

<table>
<thead>
<tr>
<th>Spatial and Mathematical-Logical</th>
<th>S-Artistic</th>
<th>S-Constructs</th>
<th>ML-Calc</th>
<th>ML-Problem Solving</th>
<th>ML-Mem/Learning</th>
<th>ML-Reasoning</th>
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</thead>
<tbody>
<tr>
<td>Ethan</td>
<td>25%</td>
<td>13%</td>
<td>38%</td>
<td>50%</td>
<td>17%</td>
<td>58%</td>
</tr>
<tr>
<td>Garrett</td>
<td>100%</td>
<td>85%</td>
<td>17%</td>
<td>75%</td>
<td>63%</td>
<td>83%</td>
</tr>
<tr>
<td>Kenyon</td>
<td>6%</td>
<td>45%</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>50%</td>
</tr>
<tr>
<td>Tressa</td>
<td>100%</td>
<td>85%</td>
<td>67%</td>
<td>92%</td>
<td>81%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 10

*Intelligence Subscales: Kinesthetic (K) and Linguistic (L)*

<table>
<thead>
<tr>
<th>Kinesthetic and Linguistic</th>
<th>K-Physicality</th>
<th>K-Dexterity</th>
<th>L-Linguistic Sensitivity</th>
<th>L-Writing</th>
<th>L-Reading</th>
<th>L-Speaking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethan</td>
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<td>42%</td>
<td>25%</td>
<td>38%</td>
<td>13%</td>
</tr>
<tr>
<td>Garrett</td>
<td>46%</td>
<td>83%</td>
<td>94%</td>
<td>100%</td>
<td>50%</td>
<td>88%</td>
</tr>
<tr>
<td>Kenyon</td>
<td>63%</td>
<td>50%</td>
<td>56%</td>
<td>0%</td>
<td>25%</td>
<td>13%</td>
</tr>
<tr>
<td>Tressa</td>
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<td>75%</td>
<td>100%</td>
<td>50%</td>
<td>50%</td>
</tr>
</tbody>
</table>
Table 11

*Intelligence Subscales: Intrapersonal (IA) and Naturalist (N)*

<table>
<thead>
<tr>
<th>Intrapersonal and Naturalist</th>
<th>IA-Self-Management</th>
<th>IA-Effective Relationships</th>
<th>IA-Goal Achievement</th>
<th>N-Animal Care</th>
<th>N-Plants</th>
<th>N-Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethan</td>
<td>25%</td>
<td>17%</td>
<td>8%</td>
<td>33%</td>
<td>50%</td>
<td>25%</td>
</tr>
<tr>
<td>Garrett</td>
<td>94%</td>
<td>75%</td>
<td>83%</td>
<td>67%</td>
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<td>81%</td>
</tr>
<tr>
<td>Kenyon</td>
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<td>50%</td>
<td>100%</td>
<td>75%</td>
<td>56%</td>
</tr>
<tr>
<td>Tressa</td>
<td>81%</td>
<td>58%</td>
<td>83%</td>
<td>83%</td>
<td>63%</td>
<td>88%</td>
</tr>
</tbody>
</table>

Table 12

*Intelligence Subscales: Interpersonal (IE) and Musical (M)*

<table>
<thead>
<tr>
<th>Interpersonal and Musical</th>
<th>IE-Leadership</th>
<th>IE-Understanding People</th>
<th>IE-Getting Along w/Others</th>
<th>M-Musicality</th>
<th>M-Vocal</th>
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</thead>
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<tr>
<td>Garrett</td>
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<td>69%</td>
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<td>75%</td>
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<tr>
<td>Kenyon</td>
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<td>25%</td>
<td>75%</td>
<td>57%</td>
<td>75%</td>
</tr>
<tr>
<td>Tressa</td>
<td>45%</td>
<td>88%</td>
<td>58%</td>
<td>50%</td>
<td>38%</td>
</tr>
</tbody>
</table>

It was becoming apparent to the researcher that the combination of Garrett’s individual intelligence strengths, working both independently and as a whole, could have provided an internal compass for his interactive narrative explorations both quantitatively and qualitatively. His high intrapersonal strength subscale scores in self-management and goal achievement, his high kinesthetic dexterity subscale score, very high spatial artistic and high constructions subscale score strengths, a high naturalist science subscale score, high math-logic strength subscale scores in problem solving and reasoning and his
very high linguistic strength linguistic sensitivity subscale scores potentially played a role in their support of both the structure and form of his electronic narrative interactions.

Though he was selected as an exemplar due to his high individual spatial and kinesthetic strengths, these findings instead suggest that it was not individual strengths in isolation that were telling but the composite of Garrett’s intelligence strengths and their various components working together as a unified whole set the stage for his *Stellaluna* exploration experience.

The fact that he had high skills in the areas of self-management, goal achievement and physical dexterity, very high artistic and linguistic sensitivity skills and additionally high skills in science, problem solving and reasoning, worked in a unified manner to co-construct his interactive narrative experience. Looking at these both individually and in combination as a profile may assist with the formation of an interactive narrative map of Garrett’s explorations. These will be discussed in more detail within the conclusions and implications of this study.

**Tressa**

Tressa, as was Garrett, was also a bright, happy and genuinely ebullient child. Of average stature and with long blonde hair, thoughtful blue eyes and a laugh that frequently bubbled forth, she looked to both adults and children around her for social support and regular conversation. She was very verbal and interacted easily with both boys and girls within the classroom. She was fond of ‘glitz’ and was a miniature fashion statement on a daily basis. She possessed successful social classroom skills and took
regular opportunities to contribute valued commentary within whole and small group classroom activities.

Of the four exemplar children observed, Tressa was the only girl and ranked fourth in her score of 136 in combined cognitive and metacognitive level of interaction during her observation and, overall, first in kinesthetic and spatial intelligence scores. Tressa’s experience with Stellaluna was also a rich one but different in many ways from that of Garrett’s experience and interaction with the CD-ROM storybook. Her interactions with Stellaluna were bathed in rich conversation and connections with realities in her daily life. Tressa was quite ready and willing to share information and knowledge about other animals and their comparisons and relationships to actions and events within Stellaluna.

She was very social and constantly interacted with the researcher as a co-participant in her viewing and online play. She began her time sharing that she could read Dr. Seuss at home and commented that red and bed were rhyming words, demonstrating growth in phonological awareness. She took great pride in her budding literacy skills! During her observation she made connections with the Stellaluna print picture book within the research environment and the CD-ROM storybook being used and made cogent and thoughtfully conceived referrals to and comparisons between both the Stellaluna print book by Janell Cannon and the CD-ROM storybook version. In fact, she mentioned that she wanted to read the book after her Stellaluna CD-ROM storybook session with the researcher. She was also the only one of the exemplar children who made connections between the DVD of Stellaluna shared in class and the CD-ROM
storybook and also the print book as she commented that “Mother bird is saying it mean
(in the CD-ROM storybook) but it’s different in the movie and the book”. And then, to
prove her point, she proceeded to get the picture storybook and showed the researcher the
page of the book to which she’s referred.

Tressa continued to make both intratextual and intertextual connections both
within and between the multiple Stellaluna texts. At one point on page 3 she pauses and
says “Wait a minute, is this picture in the book?” She checked and compared and
determined “Nope!” On another occasion for a point of comparison she held the book by
the screen and declared “No, this is the other one!” Within the story online, she would
occasionally go back and forth checking sizes of bats, looking for butterflies she
predicted were on multiple pages and to generally verify assumptions she made. Her
experiences with the multiple platforms of the Stellaluna storybook were by far the most
connected of the four exemplar children and this enhanced connection with the print text
and the associated comparisons between formats could account for her lower levels of
interaction numbers than might have been expected. While the static, non-interactive
pages were on screen, she could be easily distracted by class activities in the next room
and spent time discussing the researcher’s watch. She referred to both the CD case and
the book, on the table nearby, making connections between the story on screen and these
two related objects. This was perceived by the researcher as instances of intertextual
connection as she distinctly saw the relationship between the story in print and electronic
formats and made specific references to such.
She made numerous predictions and confirmations, as reflected in Table 7, continually talking to the researcher and commented often on actions on-screen. Tressa was ever full of questions and commentary sparked by her curiosity surrounding story events. She wondered “why bats eat fruit and birds eat bugs?” and commented that “Stellaluna doesn’t like bugs.” As she thought more about bat food she made personal life connections as she launched into a discussion of what kinds of food people like to eat. On page 1 she wondered about hippos and people and the size comparisons between human and hippo babies, on page 3 she compared bat ears to those of kangaroos, discussed the eyes on wings of butterflies and noticed specific monkeys on screen that she had seen in the zoo. She had learned via class experiences that “owls could move their heads but can’t move their eyes” and shared that as she observed the interactions between the owl and Stellaluna’s mother. On a humorous note, on page 7 when Stellaluna could not stay upright on the branch and found her inability embarrassing, Tressa commented that “Sometimes my Dad embarrasses me!” Tressa was personally invested in *Stellaluna* and saw many points of comparison within her personal reality as she interacted with the story online. Additional personal life connections were observed such as when the birds were being fed bugs by their mother she stated, “birds like bugs” and on two other occasions referring to the flying lesson of Stellaluna and the young birds when she said “birds can’t fly in the dark but bats can” and later commented on another story element, saying “this is sometimes what cats do”. She discussed freely the habits of the fruit bats in *Stellaluna* and bats in general when she shared that “Bats up at night search for food” and that “bats hang upside down”. She also freely questioned
when new thoughts occurred to her as she interacted with the CD-ROM storybook; questions such as “are owls bigger than bats?”

As represented in Table 7, her strategic access of media effects included the interactions with the parallel storyline oval on screen. She continued to interact with the storyline, labeling objects, describing actions, providing summary statements, commenting on characters, and predicting and confirming story elements throughout her online interactions. She also asked during the timed observations together if she could go to the “Bat Quiz” feature which was a priority for her and a particular favorite.

In looking at details within her MIDAS/My Young Child intelligence profile, as portrayed for all exemplars in Table 6, Tressa scored high in kinesthetic, and very high in spatial intelligence scores. Within her personal profile, they were her fifth and first highest intelligence scores, respectively. Intrapersonal, considered in the high range, was her fourth highest personal score. Within the MIDAS/My Young Child intelligence subscales as reported in Tables 9-12, in the kinesthetic Tressa scored high in physicality and very high in dexterity. The spatial subscales showed her very high in both the artistic and constructions. In looking at her combined kinesthetic and spatial scores she came in first among the exemplars. Her intrapersonal subscale scores of self-management and goal achievement were both very high. Her second highest personal intelligence score was the naturalist and she rated very high in general and also specifically very high in the science subscale.

Tressa’s combined cognitive and metacognitive interactions with the *Stellaluna* CD-ROM storybook were quantitatively lowest of the four exemplars but, based on
observational data, qualitatively very high, on a par with those of Garrett. She did, however, possess the highest combined kinesthetic and spatial intelligence strength scores of all four exemplar students. Tressa appeared to take strong advantage of opportunities to explore the different interactive pathways of the electronic narrative, and to delve deeper within the story before her. She found it an apparently easy task to integrate her personal life experiences within the story exploration and, while doing so, surrounded that process within a conversational strand that empowered her to make *Stellaluna* a part of her personal story, becoming both simultaneous interactive reader and writer. Tressa’s activity in this regard empowered her to personalize her electronic explorations. As a result, her time with the *Stellaluna* CD-ROM storybook, though different from that of Garrett, also became for her a deeper, richer experience of the interactive narrative elements at hand.

It was becoming apparent to the researcher that the combination of Tressa’s individual intelligence strengths, working both independently and as a whole, could have provided an internal compass for her interactive narrative explorations both quantitatively and qualitatively. Her high intrapersonal strength scores in self-management and goal achievement, her high kinesthetic dexterity score, very high spatial artistic and high constructions score strengths (all three identical to those of Garrett), a high naturalist science score, very high math-logic strength scores in problem solving and reasoning and her very high linguistic writing strength scores potentially played a role in their support of both the structure and form of her electronic narrative interactions.
Though she was selected as an exemplar due to her high individual spatial and kinesthetic strengths, these findings instead suggest that it was not individual strengths in isolation that were telling but the composite of Tressa’s intelligence strengths and their various components working together as a unified whole that set the stage for her *Stellaluna* exploration experience.

The fact that she had high skills in the areas of self-management, goal achievement and physical dexterity, very high artistic and construction skills and additionally high skills in science, very high skills in problem solving, reasoning and writing, worked in a unified manner to co-construct her interactive narrative experience. Looking at these both individually and in combination as a profile may assist with the formation of an interactive narrative map of Tressa’s explorations. These will be discussed in more detail within the conclusions and implications of this study.

**Ethan**

Ethan was an engaged, happy and often gregarious child. He had dark hair, and dancing brown eyes and a boisterous voice that frequently overrode other activities in his immediate vicinity. He looked to the children around him for social support and regular conversation which often found him at odds with his classroom teacher. As a result, he posed some classroom management difficulties. His personal behavior exhibited some challenges with impulse control, but he remained a very likable child. He was somewhat socially immature though interacted easily with fellow boys within the classroom. He did have some difficulties with traditional reading instruction and the reading process as well as with his social classroom skills and interactions within both whole and small group
classroom activities. He did approach his time with *Stellaluna* in great anticipation and with great enjoyment, however.

In comparing the four exemplar children observed as represented within Tables 6-8, Ethan scored second in combined cognitive and metacognitive level of interaction and lowest in both spatial and kinesthetic intelligence scores. Ethan’s experience with *Stellaluna* was verbally rich with much commentary accompanying his actions on screen. He interacted in an animated manner with both the researcher and the ongoing story and possessed a self-awareness as he progressed through various pages within the story. He ‘warned’ the birds and Stellaluna as they played with the ribbon on page 3, “Stop! It’s gonna fall!” At one point as he was preparing to move to another screen, he commented that “there’s probably more things to click on” but his plan was to continue on rather than to linger . . . a hint that his sense of duty to ‘complete’ the unfinished work on the page did not modify his inherent desire to control his pathway throughout the story action and to move on undeterred.

He did have the highest level of interaction with the individual word pronunciation options of all four children with 90 individual word clicks, in relation to the closest comparison which was 6 interactions. His word clicks appeared to be slow and measured as if he were attending to the individual pronunciations as they were spoken. Text was something that he attended to and interacted with on screen on repeated occasions . . . notably more so than the others in frequency. It may be noteworthy that of the four exemplars Ethan’s third highest intelligence was the linguistic.
He was also very aware of his surrounding environment and did note the CD case the same as did Tressa. He didn’t focus as much on the case specifically other than to inquire whether it was the ‘game’, making an intertextual connection between the Stellaluna story on screen and the physical object in the immediate vicinity. He also noticed the red light on the laser mouse he was using and inquired, “does it kill people?”, in keeping with his personal life connections with lasers, action films and video games.

As reported in Table 7, he made numerous predictions and confirmations, continually talking to the researcher and in one case said ominously, “Uh, oh! The owl. . . .” On page 3 as the bird pulls on the blue ribbon in his nest, he warns, “Stop, you’re gonna fall!” He also warns the bird who wants to try hanging upside down, “You can’t!” and turns to the researcher saying, “She’ll fall!” In addition, as the birds inquire of Stellaluna why she’s hanging upside down, Ethan exclaims in advance, “‘Cause he’s a bat!”.

He paid great attention to detail and it did not take Ethan long to notice the pattern of activity on page 1 and that there was a connection between the giraffe drinking water, eating the tree’s leaves and the appearance of the hippo after, as he states before moving to the next screen, “Wait…we have to check on the hippo”? On page 14 he notes the moon changing phases rapidly to show the passage of time and exclaims, “Whoa! How’d it do that?”

He interacted regularly with characters on screen and became involved with the conversation between the baby birds on page 3, echoing various comments, and at the very end on page 14 when Stellaluna and the birds hug, he exclaims “Awwwwww”! He
commented often on actions on-screen and made several personal life connections such as commenting about the crickets in his backyard and that, upon seeing a butterfly on screen snapped at by one of the young birds, stated that “birds like to eat butterflies.” A humorous comment from page 2 arose as he asks, “What’s that spitting water . . . a booger . . . out of his nose?” He recalls personal relationships and interactions as he notes on page 12 that Stellaluna is “hugging the mango like a Mommy.”

He makes some interesting intertextual connections with the repeated comment of “work your magic” and attributes this to the frog and the fly on page 2. It appears that Ethan has heard a phrase similar to this in other stories he’s experienced and uses this almost in a spellbinding fashion. He also made a number of intratextual connections, noting the maturation of the birds during the course of the story and after page 12 commented that “the birds are growing” but that “Stellaluna is still a baby”. He also noted on page 13 that the birds have mastered a new skill as he shouts “Hey! They’re hanging upside down!” Ethan also follows the butterfly throughout the story and notes it’s appearance and function throughout with comments such as “That’s Stellaluna – see the butterfly? – she likes Stellaluna” on page 12, “Hey, there’s the butterfly . . . see it?” on page 13 and, yet again, on page 14, “Butterfly again . . . whoa! All the butterflies”.

He commented frequently on characters and occasionally on the plot and labeled and described actions on screen. He identified the giraffe, frog and ladybug on pages 1-3. On page 9 he noted that the butterfly liked Stellaluna and that her activity on-screen was attributed to “how to find out who she is”. He accidentally clicked on the ‘Read to Me’ version and on page 2 commented that “It’s doing all of the things by itself”. He became
impatient to interact through self-clicking at will and we quickly transferred back to the ‘Play With Me’ option where the story progression was once again within his command.

Within the observational rubric (Labbo & Kuhn, 2000) metacognitive skills were measured by various categories, one of which was the strategic access of media effects. These were defined as strategic clicks on various interactive elements embedded with many storybook pages. Ethan’s strategic access of media effects included his interactions with the oval that portrayed the parallel storyline of Stellaluna’s mother. He accessed this oval, referred to by Ethan as a “bowling ball” in keeping with personal life connections with the story, on only three occasions at the beginning of the story (pages 1-3) and was not consistent in accessing and following this co-storyline information after this point. He did, however, call “Stellaluna” in chorus with the Mother during these oval interactions.

In looking at the specifics concerning his MIDAS/My Young Child intelligence scores, as represented in Table 6, his spatial intelligence score was his personal fourth highest and his kinesthetic score was his sixth, yet with both rated within the profile scale as low. The MIDAS/My Young Child intelligence subscales for each, with data reported in Tables 9-12, shows Ethan scoring low in the spatial intelligence subscales for both artistic and constructions as well as in physicality and dexterity within the kinesthetic intelligence subscales. His intrapersonal subscale scores of self-management and goal achievement were low as well. His highest personal intelligence score, though still in the low designation, was the naturalist with a low science subscale score, as well. In total, all eight of Ethan’s individual intelligence scores were rated as low within his profile.
Ethan’s combined cognitive and metacognitive interactions with the *Stellaluna* CD-ROM storybook were second highest quantitatively among the exemplars but, based on observational data, lower qualitatively than that of either Garrett or Tressa. Though slow to start, he eventually took strong advantage of the opportunity to explore the different interactive pathways of the electronic narrative and dove deep within the story before him. He, as did Garrett, appeared to have an unspoken plan for his story exploration that empowered him as a reader and also allowed a full, though occasionally repetitive, experience of the interactive narrative elements at hand.

It appeared to the researcher that the combination of Ethan’s individual intelligence strengths, much the same as Garrett and Tressa before him, working both independently and as a whole, provided an internal compass for his interactive narrative explorations both quantitatively and qualitatively. All of his intelligence strengths and their subscales registered within the low range. So strongly present in both Garrett and Tressa, the two highest scoring exemplars, however were strong intrapersonal subscale strength scores in the areas of self-management and goal achievement which were notably absent in Ethan. His naturalist strength, however, was his highest and with the content of *Stellaluna* focusing on the natural environment, the researcher speculates that this could have potentially played a role in his higher quantitative level of interactions in comparison with Garrett and Tressa, in particular. Could this overriding naturalist strength, working in combination with moderate math-logic subscale score strengths in the areas of reasoning and problem solving, moderate musical vocal subscale strengths
and a moderate linguistic intelligence linguistic sensitivity subscale strength support both the structure and form of his electronic narrative interactions?

Though he was selected as an exemplar due to his low individual spatial and kinesthetic strengths, these findings instead suggest that it was not individual strengths in isolation that were telling but the composite of Ethan’s intelligence strengths and their various components working together as a unified whole set the stage for his Stellaluna exploration experience.

The fact that he had low skills in the areas of self-management, goal achievement and physical dexterity, high skills in science, moderate skills in problem solving and reasoning and additionally moderate skills in the vocal and linguistic sensitivity subscales worked in a unified manner to co-construct his interactive narrative experience. Looking at these both individually and in combination as a profile may assist with the formation of an interactive narrative map of Ethan’s explorations. These will be discussed in more detail within the conclusions and implications of this study.

Kenyon

Kenyon was more reserved than the other exemplar students, but was a happy and pleasant child. He had dark hair, and studious brown eyes and was of an average stature. His classroom performance was mid-range and he looked to the children around him for social support and conversation. He occasionally posed some classroom management difficulties as he was often off-task and in “his own world”. His personal behavior was compliant and when given the chance to become acquainted, he was a very likable child. He, as his classmate Ethan, was somewhat socially immature and though he interacted
comfortably with both boys and girls, was more conversant with fellow boys within the classroom. He did have some difficulties with traditional reading instruction and the reading process and displayed reticence in his social classroom skills and interactions within both whole and small group classroom activities. He did approach his time with *Stellaluna* with both anticipation and enjoyment, however.

Among the four exemplar children observed, Tables 6-8 show that Kenyon scored third in combined cognitive and metacognitive level of interaction score and also ranked third in both kinesthetic and spatial intelligence scores. He enjoyed exploring the *Stellaluna* storybook and found humor in many of the story elements, characters and circumstances presented on screen. His was, however, a quieter exploration overall as he investigated and read the storybook. He immediately recognized the ‘Play With Me’ option as we began the exploration together and took control of the mouse without prompting. He did engage in fewer interactive clicks, however, as the story progressed. His was, in comparison, a more dramatic interaction as Kenyon repeated dialogues and sound effects such as the lilting ‘Stel-la-lu-na’ refrain and physically flying in his seat during certain episodes within the story. In addition, the specific connections he makes within the story have an uncanny relationship to his naturalist intelligence score, which was his highest personal intelligence strength.

Kenyon’s cognitive interactions, though not as prolific as the metacognitive were alive and active, as represented in Tables 7-8. He was involved with labeling objects, describing action, wondering, providing summary statements and commenting on characters. He became intrigued with the word play of ‘spied her’ versus spider and we
revisited these concepts once again later. Kenyon questioned “Does Stellaluna have hands?” which led to an ensuing discussion with the researcher. He later put together textual clues and when seeing her hands on pages 3-4, commented on his original question with verification of the fact. He adds to this information between pages 9-10 as he discusses her webbed ‘hands’. Kenyon successfully took new information learned within the course of the story and made extrapolations of such to expand his knowledge. Kenyon takes this learning further between pages 8-9 as he identifies, “See those little hooks? Those are her nails.”

On multiple occasions, Kenyon spends time with the parallel story ovals that showcase the experiences of Stellaluna’s mother as she escapes the owl and begins her journey in search of Stellaluna. He interacts with the oval on pages 1, 2, 4, 6, 7 and 8 for a total of six times and understands the general quest as he comments, “She’s trying to find Stellaluna” (p. 4) and as a part of these interactions comments on the specific interpersonal relationship between Stellaluna and her mother as indicated when he states, “If Stellaluna’s Mom sees her, she’ll be super mad” (p. 7).

Kenyon was involved in a number of metacognitive interactions which included prediction and confirmation behaviors. Referring to his previous interest in wordplay, he speculated in prediction “Maybe spider is the name of the owl?” On page 2, he queries, “I wonder what that one is?” as he notices a figure camouflaged within the screen tableau. With researcher prompting, he speculates it is a lizard and, upon clicking, verifies, “Yeah, it’s a tiny one . . . I can see the lizard”. He also notes the ‘sawbug’ questioning “What is it?” Having so much fun identifying and finding new animals within this screen, he
states, “I want to find something else good!” It doesn’t take Kenyon long to find the ladybug on screen and identify her as such. On page 9 he coyly asked the researcher, “Do you know what the green thing is?” and as he clicked and it appeared, responded gleefully with “Snake!” Kenyon is regularly thinking about and considering his actions and choices on-screen and not approaching the interactive tableau in a passive manner.

Kenyon was inquisitive about actions and images on screen and questioned “What’s a beak?” The researcher explained that a beak is like a nose and continuing discussion also related “nest” to the more familiar concept of house. It was obvious, as a result of this discussion, that Kenyon was making personal life connections similarly to when he was found commenting on a buzzing sound he heard on screen and identified such as an insect. Again, when he notes the lightning bugs on page 9, he quickly identifies them as lightning bugs with the knowing explanation, “because they light!” Kenyon has obviously experienced lightning bugs and their characteristics first hand and feels confident in their identification based on his personal life connections that he brings to the story experience.

Kenyon also made intratextual connections, by virtue of the story plot, in which he commented/questioned “Why do owls hate bats?” and on another occasion recognized the frog song on page 9 as one that he had heard previously. His repeated referrals to Stellaluna’s ‘hands’ also demonstrate the connections he is making within the story plot.

Kenyon’s strategic access of media effects were prolific. As mentioned previously, there were pointed instances involving his revisiting of the oval featuring the parallel storyline of the adventures of Stellaluna’s mother and his summary comment on
page 4, “She’s trying to find Stellaluna” was a perfect and unprompted indication of his understanding of the consistent theme across these vignettes. As he began the story, Kenyon initially clicked (6 instances) on individual words as well as a full text block within the interactive text. There was not a pattern that could be detected in his choice of textual clicks. These textual clicks did not occur again as the story progressed and for that reason it appears these initial exploratory clicks can be attributed more to curiosity that anything else.

In looking at the specifics concerning his MIDAS/My Young Child intelligence scores, as reflected in Table 6, his spatial intelligence score was his sixth highest, but rated low within the profile and his kinesthetic score, rated high, was his second highest. In looking at the intelligence subscales for each, with data found in Tables 9-12, Kenyon scored very low in the spatial intelligence subscale for artistic and moderate for constructions while he scored moderate in both physicality and dexterity within the kinesthetic intelligence subscales. His intrapersonal score was also rated moderate within the profile, as were his intrapersonal intelligence subscale scores in both self-management and goal achievement. His highest personal intelligence score was the naturalist, rating a high. Within this area, he scored moderately in the science subscale.

Kenyon’s combined cognitive and metacognitive interactions with the Stellaluna CD-ROM storybook were third highest quantitatively but, as with his classmate Ethan, were lower qualitatively than that of either Garrett or Tressa. Though a more reserved but physical exploration overall, he also took a strong advantage of the opportunity to explore the different interactive pathways of the electronic narrative and dove deep
within the story before him. His dramatic, thoughtful and measured approach was qualitatively different than the other exemplars but his particular personal approach was one that empowered him as a reader and his unique physical involvement with the story resulted in a full experience of the interactive narrative elements at hand.

It appeared to the researcher that the combination of Kenyon’s individual intelligence strengths, much the same as Garrett, Tressa and Ethan before him, working both independently and as a whole, provided an internal compass for his interactive narrative explorations both quantitatively and qualitatively. His moderate intrapersonal subscale strength scores in self-management and goal achievement, his moderate kinesthetic dexterity and physicality subscale scores, moderate spatial constructions subscale score strength, moderate math-logic reasoning subscale strength score and his moderate musical musicality and vocal strength subscale scores potentially played a role. His intrapersonal scores could be perceived as showing a measure of internal control as he interactively made his way through the content at hand. His naturalist strength, as was Ethan’s, was his highest and also strongest across the subscales. Within this naturalist strength, Kenyon possessed very high animal care and moderate plants and science subscale scores. In consideration of the content of *Stellaluna* focusing on the natural environment with an emphasis in all three of his subscale strengths, the researcher once again speculates that this could have potentially played a role in his higher quantitative level of interactions in comparison with Garrett and Tressa, in particular.

Though he was selected as an exemplar due to his low individual spatial and kinesthetic strengths, these findings instead suggest that it was not individual strengths in
isolation that were telling but the composite of Kenyon’s intelligence strengths and their various components working together as a unified whole that set the stage for his *Stellaluna* exploration experience.

The fact that he had moderate skills in the areas of self-management, goal achievement, physicality, dexterity, reasoning, spatial constructions, musicality and vocal and additionally very high skills in animal care and moderate skills in science and plants subscales worked in a unified manner to co-construct his interactive narrative experience. Could this overriding naturalist strength, in combination with his more moderate score strengths in the intrapersonal and math-logic as well have an effect? Could Kenyon’s uniquely dramatic approach to the story, as supported by his moderate musical and kinesthetic strengths support both the structure and form of his electronic narrative interactions? Looking at these both individually and in combination as a profile may assist with the formation of an interactive narrative map of Kenyon’s explorations. These will be discussed in more detail within the conclusions and implications of this study.

**Relationship Analyses**

In this section we’ll look at the intersection of the results from both the quantitative relationship analysis and the qualitative observational data gathered. Each of the eight hypotheses looked at possible existing relationships between the combined cognitive and metacognitive levels of student interactions with the electronic storybook and each of the eight individual intelligences as determined by Howard Gardner’s Theory of Multiple Intelligence (c. 1983).
Within all of the observational analyses the combined cognitive and metacognitive level of interaction, as viewed in Table 13, was scored via the child’s interactions with the CD-ROM storybook defined via activities such as labeling, describing action, wondering, providing summary statements, and commenting on characters, plot and theme plus predicting and confirming behaviors, intratextual and personal life connections and the strategic access of media effects. The eight multiple intelligence strengths of the sample of 32 Kindergarten students, measured via the MIDAS/My Young Child (Shearer, 1994-2002) instrument was then correlated with their combined cognitive and metacognitive levels of interaction with the electronic CD-ROM storybook as measured by the researcher’s adaptation of a rubric used by Labbo and Kuhn (2000).

Table 13

*Exemplar Combined Interactions with Storybooks*

<table>
<thead>
<tr>
<th>Exemplar Interactions w/Storybooks</th>
<th>Cognitive</th>
<th>Metacognitive</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethan</td>
<td>55</td>
<td>127</td>
<td>182</td>
</tr>
<tr>
<td>Garrett</td>
<td>99</td>
<td>202</td>
<td>301</td>
</tr>
<tr>
<td>Kenyon</td>
<td>43</td>
<td>97</td>
<td>140</td>
</tr>
<tr>
<td>Tressa</td>
<td>46</td>
<td>90</td>
<td>136</td>
</tr>
</tbody>
</table>
Hypothesis One

The first hypothesis looked at the possible relationship in regards to that between the combined cognitive and metacognitive levels of interaction and the interpersonal intelligence strength. This was not supported within correlational analyses. In fact a very low and statistically insignificant relationship existed between the two variables as demonstrated in Table 5.

But, nonetheless, in looking at the leadership, understanding people and getting along with others subscales of the interpersonal intelligence, as demonstrated in Table 12, the scores of the four exemplar children may hold some helpful keys to understanding. This will be discussed in the Exemplar Relationship Cross-Case Analysis.

Hypothesis Two

The second hypothesis looked at the possible relationship between combined cognitive and metacognitive levels of interaction and intrapersonal intelligence strength. This hypothesis was supported more strongly within the linear correlational analysis. In fact a statistically significant positive relationship was found between the two variables as shown in Table 5. The metacognitive component of the interaction with the CD-ROM storybooks and its strong connection with the need for students’ to be aware of their actions and plans as they became co-creators and tellers of the story could explain the stronger and significant showing in the correlation between the intrapersonal intelligence and the levels of interaction.

In addition, looking at the self-management, effective relationships and goal achievement subscales of the intrapersonal intelligence, the scores of the four exemplar
children may hold some helpful keys to understanding. This will be discussed further in the Exemplar Relationship Cross-Case Analysis.

**Hypothesis Three**

The third hypothesis looked at the possible relationship between combined cognitive and metacognitive levels of interaction and the kinesthetic intelligence strength. This hypothesis was minimally supported within the linear correlative analysis. In fact, a minimal positive yet statistically insignificant relationship existed between the two variables as reflected in Table 5. The researcher predicted that the interactivity of the CD-ROM storybooks might support children with higher kinesthetic intelligence strengths as they physically respond within the interactive tableau of stories in electronic format.

Kinesthetic intelligence strengths were also scored via two subscales that indicated a child’s physicality and dexterity. Though physicality may not hold a strong relationship to interactions with the storybooks, a child’s dexterity score, indicating their potential skill and flexibility with navigating the CD-ROM storybook could be much more telling. In looking at the physicality and dexterity subscales of the kinesthetic intelligence, the scores, as reflected in Table 10, of the four exemplar children may hold some helpful keys to understanding. This will be discussed in the Exemplar Relationship Cross-Case Analysis.

**Hypothesis Four**

The fourth hypothesis examined the possible relationship between combined cognitive and metacognitive levels of interaction and the linguistic intelligence strength.
This hypothesis was minimally supported within the linear correlational analyses. In fact a very low positive, though statistically insignificant, relationship was found between the two variables, as represented within Table 5.

Similarly, though, in looking at the linguistic sensitivity, writing, reading and speaking subscales of the linguistic intelligence, the scores of the four exemplar children may still hold some helpful keys to understanding as represented in Table 10. This will be discussed in the Exemplar Relationship Cross-Case Analysis.

**Hypothesis Five**

The fifth hypothesis examined the possible relationship between combined cognitive and metacognitive levels of interaction and the math-logical intelligence strength. This hypothesis was minimally supported within the linear correlational analysis. In fact a low positive, though not statistically significant, relationship was found between the two variables as illustrated in Table 5.

Though, in looking at the calculations, problem solving, memorization/learning and reasoning subscales of the math-logical intelligence, as reflected in Table 9, the scores of the four exemplar children may hold some helpful keys to understanding. If so, this will be discussed in the Exemplar Relationship Cross-Case Analysis.

**Hypothesis Six**

The sixth hypothesis examined the possible relationship between the combined cognitive and metacognitive levels of interaction and musical intelligence strength. This hypothesis was not supported within the correlational analysis. A very low positive and
statistically insignificant relationship was found between the two variables as demonstrated in Table 5.

Though musical opportunities and various songs existed not only at consistently and universally experienced locations within the story, they also appeared within occasional and individually chosen interactive hot-spots, depending upon the individual students’ interactions and explorations. Musical intelligence strengths were scored via the musicality and vocal subscales. These subscale scores, as reflected in Table 12, for the four exemplar children, however, may hold some helpful keys to understanding.

**Hypothesis Seven**

The seventh examined the possible relationship between combined cognitive and metacognitive levels of interaction and naturalist intelligence strength. As demonstrated in Table 5, this hypothesis was supported more strongly within the linear correlational analysis. In fact a statistically significant positive relationship was found between the two variables. Due to the topic and theme of the *Stellaluna* storybook being one dealing with animals, plants and natural habitats and possessing a scientific parallel throughout, this could have had an impact on the relationship results represented within this study. This will be discussed in more detail within the conclusions and implications of this study.

In looking at the animal care, plants and science subscales of the naturalist intelligence, the subscale scores of the four exemplar children may hold some helpful keys to understanding. Both Ethan and Kenyon, the lowest scoring exemplars, had the naturalist intelligence strength as their highest. Could that have compensated and elevated their combined cognitive and metacognitive interactions to be comparable to
those of Garrett and Tressa, the higher scoring exemplars? This possibility will be discussed in the Exemplar Relationship Cross-Case analysis.

**Hypothesis Eight**

The eighth and final hypothesis looked at this possible relationship in regards to the combined cognitive and metacognitive levels of interaction and spatial intelligence strength. This hypothesis was minimally supported within linear correlational analyses. In fact a low non-significant positive relationship was found between the two variables as reflected in Table 5. Initially the researcher predicted that due to the combination of the verbal and visual components of CD-ROM storybooks it would be expected that these elements would encourage and facilitate the combined cognitive and metacognitive level of interaction that children with high spatial abilities would have with the story on-screen.

Spatial intelligence strengths were also scored more specifically via two subscales; artistic and constructions. In looking at the artistic and constructions subscales of the spatial intelligence, the scores, as reflected in Table 9, of the four exemplar children may hold some helpful keys to understanding. This will be discussed in the Exemplar Relationship Cross-Case Analysis.

**Exemplar Relationship Cross-Case Analysis**

In this section we’ll look at the individual exemplar student qualitative observational data in relationship to each other in a cross-case analysis. Looking at the similarities and differences between their combined cognitive and metacognitive levels of interaction, their intelligence strength scores as well as their various subscale scores
within each intelligence may hold some special insights and pave a smoother and more substantial path to understanding. We’ll begin by examining general characteristics of the high scorers and low scorers and then specific examinations of the eight intelligences and their subscales.

**High-Scoring Exemplars**

The higher scoring exemplars, Tressa and Garrett, not only had a high level of combined cognitive and metacognitive interactions with the CD-ROM storybook, they also had very high and rich levels of conversation amidst their interactions. Garrett was very conversant with the story, anticipating actions and events in the story grammar based on his previous experiences using *Stellaluna*. Tressa’s experiences with *Stellaluna* were also bathed in rich conversation and personal life and knowledge connections. Both of these exemplar students interacted within the context of a social repartee with the researcher throughout. Their ability to interact interpersonally on this level with the researcher and still manage the physical dexterity and metacognitive skills necessary to navigate throughout the CD-ROM storybook in the manner demonstrated seems to indicate the presence of an intelligence strength balance and compensation, perhaps much akin to that alluded to within the discussion surrounding the spatial intelligence results. This potential compensation will be addressed in more detail within the interpersonal intelligence strength and its subscales when looking more closely at its cross-case analysis. In addition, both scored high or very high, not only in kinesthetic, but also within the spatial and intrapersonal intelligences. The powerful combination of the
artistic, dexterity, self-management and goal-achievement subscales across these three intelligences are evident in both of these exemplars.

**Low Scoring Exemplars**

In looking at Ethan and Kenyon, the two lower scoring exemplars, both boys scored lowest not only in their spatial and kinesthetic strength scores, but also in their intrapersonal intelligence score as noted in Table 6. Even so, Kenyon’s kinesthetic strength was his second highest and rated high within the MIDAS/My Young Child scale while Ethan’s kinesthetic was his sixth highest intelligence and rated low within the MIDAS/My Young Child scale. Both boys, however, had their highest scores in the naturalist intelligence. Again, the connection between the theme and content of the Stellaluna storybook with their highest intelligence strength scores and its possible ability to mitigate and balance their lower scores in the spatial and kinesthetic may be an active element to be considered here. Though their strengths were lower in the kinesthetic area, their levels of combined interaction with the storybook remained higher than would be expected. The level of interpersonal interaction and conversation with the researcher and about the storybook, though present, was not at the same elevated level as that of Garrett and Tressa, but both Kenyon and Ethan’s approach was more of a ‘just the facts ma’am’ model, with activity on screen the primary focus and conversation about such secondary.

**Interpersonal Intelligence**

In looking at the leadership, understanding people and getting along with others subscales of the interpersonal intelligence, as demonstrated in Table 14, the child holding the highest interpersonal intelligence score, Garrett, scored a high in both the leadership
Table 14

*Student Exemplar Cross Case Analysis Interpersonal*

<table>
<thead>
<tr>
<th>Interpersonal Correlations w/Combined Storybook Interactions</th>
<th>Exemplars</th>
<th>Combo Cog/Metacog Interacts</th>
<th>Interpersonal And Subscales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear .263</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethan 182</td>
<td></td>
<td>23%</td>
<td>19%</td>
</tr>
<tr>
<td>Garrett 301</td>
<td></td>
<td>64%</td>
<td>65%</td>
</tr>
<tr>
<td>Kenyon 140</td>
<td></td>
<td>41%</td>
<td>35%</td>
</tr>
<tr>
<td>Tressa 136</td>
<td></td>
<td>61%</td>
<td>45%</td>
</tr>
<tr>
<td>Linear Two Tailed Sig. (.05) .106</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethan 182</td>
<td></td>
<td>23%</td>
<td>19%</td>
</tr>
<tr>
<td>Garrett 301</td>
<td></td>
<td>64%</td>
<td>65%</td>
</tr>
<tr>
<td>Kenyon 140</td>
<td></td>
<td>41%</td>
<td>35%</td>
</tr>
<tr>
<td>Tressa 136</td>
<td></td>
<td>61%</td>
<td>45%</td>
</tr>
</tbody>
</table>

and understanding people subscales, and moderate in the getting along with others subscale. Tressa, the second highest interpersonal scorer, possessed a moderate score in leadership and in getting along with others subscales and very high in the understanding people subscale. Of the four exemplars, Kenyon scored third in interpersonal, and had low leadership and understanding people subscale scores and a high getting along with others score. Ethan, scoring the lowest, possessed a low score in leadership, a moderate score in understanding people and scored very low in getting along with others. Garrett and Tressa’s combined strengths in the interpersonal, particularly perhaps in the area of leadership, provided them with buoyant skills that equipped them with a higher level of perseverance and perhaps worked in consort with their higher spatial and kinesthetic strengths. The absence of these strong interpersonal skills for Ethan and Kenyon resulted
in a comparably lower level of engaged conversation with the researcher during their
time with the Stellaluna storybook, but also potentially could have elevated their level of
interaction scores with their more singular focus. Conversely, Garrett and Tressa’s
management of a relatively high level of conversation with the researcher in keeping with
their higher interpersonal strengths could have also resulted in a false devolution of the
level of interaction scores. The combination of these two potential effects might explain
their counterintuitively similar levels of interaction in light of their intelligence strengths.

**Intrapersonal Intelligence**

The child holding the highest intrapersonal intelligence score among the
exemplars, Garrett, as reflected in Table 15, scored very high in the self-management
subscale and high in the effective relationships and goal achievement subscales in
relation to the MIDAS/My Young Child benchmarks. Within his personal MIDAS
profile, this was Garrett’s second highest intelligence strength. Tressa, the second
highest intrapersonal scorer among the exemplars, scored high in the self-management
and goal achievement subscales and moderate in the effective relationships subscale
when comparing her scores to the MIDAS/My Young Child benchmarks. This was
Tressa’s fourth highest intelligence strength within her personal MIDAS profile. Of the
four exemplars Kenyon, scored third comparatively in intrapersonal, and had moderate
scores in all of the MIDAS benchmark subscales; self-management, effective
relationships and goal achievement. This was Kenyon’s fourth highest intelligence
strength within his personal profile. Ethan, scoring the lowest among the exemplars,
possessed a low MIDAS benchmark score in the self-management subscale and very low
in the effective relationships and goal achievement subscales. This was Ethan’s eighth, and lowest, personal profile intelligence strength. As mentioned previously, Garrett and Tressa’s top scores amongst the exemplars in the intrapersonal, particularly in light of their high MIDAS benchmark scores in self-management and goal achievement, in comparison to Ethan and Kenyon, could have acted in consort with their spatial and kinesthetic strengths, placing them clearly on top as the high scoring exemplars. Their ability to self-manage combined with their high goal achievement motivation was a winning combination and support toward a higher quality interaction.

Table 15

*Student Exemplar Cross Case Analysis Intrapersonal*

<table>
<thead>
<tr>
<th>Intrapersonal Correlations w/Combined Storybook Interactions</th>
<th>Exemplars</th>
<th>Combo Cog/Metacog Interacts</th>
<th>Intrapersonal And Subscales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear .389</td>
<td>Ethan</td>
<td>182</td>
<td></td>
</tr>
<tr>
<td>Linear Two Tailed Sig. (.05) .014</td>
<td>Garrett</td>
<td>301</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kenyon</td>
<td>140</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tressa</td>
<td>136</td>
<td></td>
</tr>
</tbody>
</table>

**Kinesthetic Intelligence**

In viewing the numerical data of the exemplar children for both kinesthetic subscales in Table 16, Tressa, the top scorer amongst the exemplars, had high personal profile scores, using the MIDAS benchmarks, in both physicality and dexterity. The
second highest of the exemplars, Garrett, had a moderate profile score in physicality and high in dexterity within the MIDAS benchmark scale. Kenyon, the third highest scorer of the exemplars, had moderate personal profile MIDAS scale scores in both physicality and dexterity. Ethan, the lowest scorer of the exemplars in this intelligence, had a low personal MIDAS benchmark score in physicality and very low in dexterity.

The lower personal profile dexterity scores that both Kenyon and Ethan had in common could have had an impact on their physical maneuverability and hence on their interactions, but there appeared to be a parallel factor at work here to balance and keep interactions at a comparably high level to those of Garrett and Tressa, in particular. These lower kinesthetic subscale scores, however, did not have a linear correlation with level of interaction. It appears that perhaps level of interaction scores might have a tendency to peak with students possessing both high and low kinesthetic strengths.

Table 16

*Student Exemplar Cross Case Analysis Kinesthetic*

<table>
<thead>
<tr>
<th>Kinesthetic Correlations w/ Combined Storybook Interactions</th>
<th>Exemplars</th>
<th>Combo Cog/ Metacog Interacts</th>
<th>Kinesthetic And Subscales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear .190</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethan</td>
<td>182</td>
<td>27%</td>
<td>33%</td>
</tr>
<tr>
<td>Garrett</td>
<td>301</td>
<td>61%</td>
<td>46%</td>
</tr>
<tr>
<td>Kenyon</td>
<td>140</td>
<td>61%</td>
<td>63%</td>
</tr>
<tr>
<td>Tressa</td>
<td>136</td>
<td>68%</td>
<td>79%</td>
</tr>
</tbody>
</table>

Linear Two Tailed Sig. (.05) .246
**Linguistic Intelligence**

As noted in Table 17, the child holding the highest linguistic intelligence score among the exemplars, Garrett, scored very high in his personal profile MIDAS/My Young Child benchmarks within the linguistic sensitivity, speaking and writing subscales and moderately in the reading subscale. This was Garrett’s third highest intelligence within his personal MIDAS/My Young Child profile. Tressa, the second highest linguistic scorer of the four exemplars, possessed a high personal profile score in linguistic sensitivity subscale, very high in the writing subscale, and moderate scores in both the reading and speaking subscales within the MIDAS/My Young Child benchmarks. This was Tressa’s fourth highest personal profile intelligence. Of the four exemplars Ethan, scored third in linguistic and had moderate MIDAS/My Young Child benchmark scores in the linguistic sensitivity, writing and reading subscales and a very low score in the speaking subscale. This was Ethan’s third highest intelligence within his personal profile. Kenyon, scoring the lowest of the exemplars in this area, possessed a moderate MIDAS/My Young Child benchmark score in the linguistic sensitivity subscale, low in the reading subscale and very low scores in the speaking and writing subscales. This was Kenyon’s seventh highest personal MIDAS/My young Child profile intelligence.

These strengths and weaknesses were evident both through their level of interactivity with hot-spots as indicated through their strategic access of various media effects as indicated through their metacognitive level of interaction but also as demonstrated through a general lack of interaction with the textual components on the
electronic tableaux before them. Only one of the exemplar children spent any time clicking on the on-screen text. In addition, part of the reason for the low correlational

Table 17

**Student Exemplar Cross Case Analysis Linguistic**

<table>
<thead>
<tr>
<th>Linguistic Correlations w/Combined Storybook Interactions</th>
<th>Exemplars</th>
<th>Combo Cog/ Metacog Interacts</th>
<th>Linguistic And Subscales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear .128</td>
<td>Ethan</td>
<td>182 34% 42% 25% 38% 13%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Garrett</td>
<td>301 79% 94% 100% 50% 88%</td>
<td></td>
</tr>
<tr>
<td>Linear Two Tailed Sig (.05) .438</td>
<td>Kenyon</td>
<td>140 27% 56% 0% 25% 13%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tressa</td>
<td>136 75% 75% 100% 50% 50%</td>
<td></td>
</tr>
</tbody>
</table>

relationship could be due to the children’s lack of familiarity with responding to electronic text in this way without teacher prompting and, as mentioned previously, could support the notion that having the teacher as a coach/facilitator alongside children in their use of CD-ROM storybooks could enhance their combined cognitive and metacognitive level of interaction with these electronic texts. (Matthew, 1997) The interactive hot-spots, features that proliferate throughout the illustrations and text, when perceived as distractions, have the potential ability to steer children, without teacher support and intervention, away from verbalizing their actions and simply interacting visually and
physically with the visual and oral features of the story, possibly, to the exclusion of the
textual components. (Trushell, Burrell and Maitland, 2001)

Math-Logical Intelligence

As evidenced in Table 18, Tressa held the highest math-logic score of the four,
scoring very high overall within her personal MIDAS/My Young Child profile as well as
possessing very high scores in three of the pertinent subscales; problem solving,
reasoning and memorization-learning. This was her third highest intelligence within her
personal profile. Garrett, the second highest math-logic scorer amongst the exemplars
with a high-moderate MIDAS/My Young Child benchmark score overall, similarly, also
had high-moderate scores in the problem solving, reasoning and memorization-learning
personal subscales as well.

Table 18

Student Exemplar Cross Case Analysis Math-Logical

<table>
<thead>
<tr>
<th>Math-Logic Correlations w/Combined Storybook Interactions</th>
<th>Exemplars</th>
<th>Combo Cog/Metacog Interacts</th>
<th>Math-Logic And Subscales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exemplars</td>
<td>Calculating</td>
<td>Mem/Lrng</td>
<td>Prob Solve</td>
</tr>
<tr>
<td>Ethan 182</td>
<td></td>
<td>35%</td>
<td>38%</td>
</tr>
<tr>
<td>Garrett 301</td>
<td></td>
<td>62%</td>
<td>17%</td>
</tr>
<tr>
<td>Kenyon 140</td>
<td></td>
<td>35%</td>
<td>25%</td>
</tr>
<tr>
<td>Tressa 136</td>
<td></td>
<td>81%</td>
<td>67%</td>
</tr>
</tbody>
</table>

Linear .281

Linear Two Tailed Sig. (.05) .083
His math-logic score was his MIDAS personal profile’s seventh highest but was similar in nature to that of his kinesthetic, interpersonal and musical scores within his individual profile.

The math-logic found both Ethan and Kenyon tying for third amongst the exemplars comparative scores. This was Ethan’s second highest MIDAS/My Young Child profile intelligence with a low-moderate benchmark score in this area. His problem solving and reasoning subscale scores were in the solid moderate range. Kenyon’s math-logic MIDAS/My Young Child profile score was identical to that of Ethan. The difference lay in Kenyon’s more singular strength in the reasoning subscale benchmark. The math-logic ties with the spatial for Kenyon’s sixth highest intelligence strength within his personal MIDAS/My Young Child profile.

One consistency among the four exemplars are the strengths they hold in the reasoning subscale benchmark. All four scored in the moderate to very high range in this area. Problem solving subscale benchmark scores were also in a similar range for all but Kenyon. The level of consistency in these subscales of reasoning and problem solving could indicate that student strengths in these areas facilitated their frequent successful navigation of the storybook as well as heightened their level of interaction within such.

**Musical Intelligence**

Student strengths in the musical intelligence lay mainly in the low to high moderate range within their personal profiles, as seen in Table 19, with Garrett’s high musicality subscale benchmark score and Kenyon’s high vocal subscale benchmark score as the two standouts among the exemplars. It was Kenyon’s third personal highest,
Ethan’s fourth personal highest, Garrett’s sixth personal highest and Tressa’s lowest personal intelligence.

Table 19

**Student Exemplar Cross Case Analysis Musical**

<table>
<thead>
<tr>
<th>Musical Correlations w/Combined Storybook Interactions</th>
<th>Exemplars</th>
<th>Combo Cog/ Metacog Interacts</th>
<th>Musical And Subscales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear .128</td>
<td>Ethan</td>
<td>182</td>
<td>28%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>18%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>63%</td>
</tr>
<tr>
<td></td>
<td>Garrett</td>
<td>301</td>
<td>63%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50%</td>
</tr>
<tr>
<td>Linear Two Tailed Sig. (.05) .436</td>
<td>Kenyon</td>
<td>140</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>57%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>Tressa</td>
<td>136</td>
<td>45%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>38%</td>
</tr>
</tbody>
</table>

One area in which the musical intelligence was apparent was within Kenyon’s activity with the storybook. Kenyon was the one exemplar who repeated sound effects such as the lilting “Stel-la-lu-na” refrain throughout.

**Naturalist Intelligence**

The motivation to interact with the storybook based on the exemplars’ personal and intrinsic interest in animals and science, as demonstrated within their MIDAS/My Young Child personal subscale scores of the naturalist intelligence could be a root cause for some unexpected trends being evident both within this small exemplar group as well as within the sample as a whole.
Of the four exemplars, as noted in Table 20, only Ethan had a low personal profile score within the naturalist subscales. Even so, the naturalist was Ethan’s highest MIDAS/My Young Child profile intelligence score. The other low scoring exemplar, Kenyon, held naturalist as his highest personal profile strength as well. Could it be that the low exemplars’ strong representation in the naturalist intelligence strength perhaps combined with the topic and theme of the *Stellaluna* storybook, immersed in that of animals, plants and natural habitats/science, worked in consort with their other intelligence strengths to place them on a more even playing field, in terms of their combined cognitive and metacognitive interactions, with the two highest scoring exemplars, Garrett and Tressa? When student strengths and concurrent correlational relationships are not as evident in the spatial and

*Table 20*

*Student Exemplar Cross Case Analysis Naturalist*

<table>
<thead>
<tr>
<th>Naturalist Correlations w/Combined Storybook Interactions</th>
<th>Exemplars</th>
<th>Combo Cog/ Metacog Interacts</th>
<th>Naturalist And Subscales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear .379</td>
<td>Ethan</td>
<td>182</td>
<td>36% 33% 50% 25%</td>
</tr>
<tr>
<td>Linear Two Tailed Sig. (.05) .017</td>
<td>Garrett</td>
<td>301</td>
<td>75% 67% 50% 81%</td>
</tr>
<tr>
<td></td>
<td>Kenyon</td>
<td>140</td>
<td>80% 100% 75% 56%</td>
</tr>
<tr>
<td></td>
<td>Tressa</td>
<td>136</td>
<td>84% 83% 63% 88%</td>
</tr>
</tbody>
</table>
kinesthetic strengths, for example, as predicted by the researcher, or for any other intelligence strengths for that matter, there appear to be other strengths present that rise to the occasion and which perhaps shore up and balance the weaknesses in the strengths under examination and analysis.

**Spatial Intelligence**

In looking more intently at the spatial intelligence, the child holding the highest spatial intelligence score amongst the exemplars, Tressa, scored very high in both artistic and the constructions MIDAS/My Young Child benchmark subscales. In these areas, Garrett, the second highest exemplar spatial scorer, possessed identical personal profile scores to Tressa. Of the four exemplars, Kenyon, scored third in spatial, and, within the MIDAS/My Young Child benchmarks, had a low artistic subscale score and moderate constructions subscale score within his personal profile. Ethan scored the lowest, among the exemplars, in both artistic and constructions subscales within his personal MIDAS/My Young Child profile. The similar spatial strength scores that group both the highest and lowest scoring exemplars, respectively, solidly separate their skills in the spatial arena but there is not a distinguishable pattern within the specific metacognitive or cognitive interactions that groups exemplars in the same way.

Though Garrett’s strategic access of media effects is much higher than the other three exemplars as are his comments on characters, summary statements and descriptions of activities, it was apparent that a rich, deeper level of the Stellaluna storybook experience, by both higher scoring exemplars Garrett and Tressa, was quite evident in
taking a closer look at their interactions. As reflected in Table 21, with both scoring very high in their personal profiles’ artistic subscale and both having over 100 combined cognitive and metacognitive interactions total for each, they both scored higher in metacognitive than cognitive interactions and were actively involved in both predicting and confirming behaviors as well as in their strategic access of media effects.

Table 21

**Student Exemplar Cross Case Analysis Spatial**

<table>
<thead>
<tr>
<th>Spatial Correlations w/Combined Storybook Interactions</th>
<th>Exemplars</th>
<th>Combo Cog/Metacog Interacts</th>
<th>Spatial And Subscales</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Intelligence</td>
<td>Artistic</td>
</tr>
<tr>
<td>Linear .132</td>
<td>Ethan</td>
<td>182</td>
<td>31%</td>
</tr>
<tr>
<td></td>
<td>Garrett</td>
<td>301</td>
<td>88%</td>
</tr>
<tr>
<td>Linear Two Tailed Sig. (.05) .423</td>
<td>Kenyon</td>
<td>140</td>
<td>35%</td>
</tr>
<tr>
<td></td>
<td>Tressa</td>
<td>136</td>
<td>92%</td>
</tr>
</tbody>
</table>

**Summary of Cross Case Analysis**

This cross-case analysis of the four student exemplars demonstrated the distinct and consistent interplay of specific MIDAS/My Young Child personal profile intelligence and intelligence subscale strength contrasts and comparisons and potential relationships therein. The probable interplay of the various intelligence strengths within a student’s intelligence tableau and how this interplay might have impacted linear correlation results
lead to further considerations that a reasonable conclusion of data sets as a whole may indicate a student’s unique intelligence profile and its effect upon levels of interactions with the CD-ROM storybook is a stronger determinant than the effect of the individual intelligence strengths in isolation. It is as if the individual intelligence strengths engaged in a skillful dance to weave a tapestry of response that balanced strengths and weaknesses, transforming the experience into the best it could be for each student exemplar.

These findings suggest that rather than focusing on or looking to the measure of personal individual intelligence strengths as the answer to student excellence, rather focus on assisting students not only in developing their personal individual intelligence strengths but also in how to use strengths and weaknesses to their advantage within a unique package or profile that highlights the most successful personal resolution for each individual student.

**Member Checks and Teacher MIDAS Beta Instrument Results for Student**

Though not holding solid validity or reliability data, teachers were requested to complete a beta MIDAS instrument that offered them the opportunity to provide their perceptions of student intelligence strengths as a comparative triangulation tool to use with the results of the parent-driven MIDAS/My Young Child document.

For the four exemplar students, in particular, parental and teacher MIDAS scores differed in a number of areas and were fairly similar in others. Both the MIDAS Teacher and the MIDAS/My Young Child were based upon a total possible score/rank of 100%. For example, as seen in Table 22, her teacher rated Tressa with a 56% in kinesthetic, a 94% in spatial and a 69% in intrapersonal strengths. Ethan’s teacher rated him with a
13% in kinesthetic, a 38% in spatial and a 19% in intrapersonal strengths. Kenyon’s teacher rated him with a 6% in kinesthetic, a 44% in spatial and a 0% in intrapersonal strengths.

Table 22

**Multiple Intelligence Strengths of Students Comparison of Teacher/Parent Results**

<table>
<thead>
<tr>
<th>Group/Student</th>
<th>Inter</th>
<th>Intra</th>
<th>Kin</th>
<th>Ling</th>
<th>Math-Log</th>
<th>Mus</th>
<th>Nat</th>
<th>Spat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>88</td>
<td>89</td>
<td>94</td>
<td>90</td>
<td>38</td>
<td>52</td>
<td>69</td>
<td>63</td>
</tr>
<tr>
<td>Tresa</td>
<td>38</td>
<td>61</td>
<td>69</td>
<td>75</td>
<td>56</td>
<td>68</td>
<td>56</td>
<td>75</td>
</tr>
<tr>
<td>1-2</td>
<td>38</td>
<td>73</td>
<td>100</td>
<td>71</td>
<td>63</td>
<td>55</td>
<td>81</td>
<td>79</td>
</tr>
<tr>
<td>Garrett</td>
<td>75</td>
<td>64</td>
<td>100</td>
<td>83</td>
<td>31</td>
<td>61</td>
<td>100</td>
<td>79</td>
</tr>
<tr>
<td>1-3</td>
<td>31</td>
<td>50</td>
<td>60</td>
<td>50</td>
<td>88</td>
<td>48</td>
<td>81</td>
<td>54</td>
</tr>
<tr>
<td>1-4</td>
<td>0</td>
<td>64</td>
<td>6</td>
<td>39</td>
<td>0</td>
<td>44</td>
<td>13</td>
<td>60</td>
</tr>
<tr>
<td>1-5</td>
<td>31</td>
<td>64</td>
<td>50</td>
<td>63</td>
<td>0</td>
<td>45</td>
<td>56</td>
<td>83</td>
</tr>
<tr>
<td>1-6</td>
<td>38</td>
<td>63</td>
<td>100</td>
<td>61</td>
<td>100</td>
<td>66</td>
<td>100</td>
<td>65</td>
</tr>
<tr>
<td>1-7</td>
<td>50</td>
<td>61</td>
<td>44</td>
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Teacher rankings for students overall were lower that parent rankings. One assumes parents are more cognizant of their child’s strengths as they spend more time with them within the home environment, but both teachers expressed surprise at the differences and thought perhaps that parents didn’t know their children as well as they thought, particularly in how intelligence strengths played out within classroom activities and interactions. To quote Meredith, “in general I think that this group of parents did not have as realistic a grasp on their child’s learning. I remember having conferences and realizing that many of the parents ‘saw’ a different child than I did!”

**Parent Evaluations of MIDAS Instrument Results**

When student MIDAS/My Young Child profiles were returned to individual parents through their classroom teacher, a cover letter accompanied such. There was also distributed simultaneously a Parent Reflection Form (Appendix) with requests to return to the researcher through the classroom teachers.

The Parent Reflection was an attempt to gauge parental views and feedback on their child’s profile results in regards to whether each intelligence strength score was considered too high, too low or on-target as well as the same considerations for their individual composite profile score. A few additional questions asked which intelligence scale scores surprised or puzzled them, what they learned from the assessment and which strengths the parents and children were in agreement with.

Of 39 Parent Reflections distributed, 13 were returned, resulting in a 33% completion rate. Within this return, however, not all questions were answered by all parents consistently. Parents did respond that 77% of the individual profile strength
ratings were on target while 14% were too low and 9% too high. With one parent not responding, of the remaining 12, 77% thought the composite profiles were on target, but 15% responded they were ‘mixed-up.’

Surprises existed for seven parents in the linguistic (3), spatial (2) and musical (2) intelligence scores. Three parents were puzzled by the kinesthetic, math-logic and linguistic scales. In both surprises and puzzlements, accompanying parental commentary, based on their actual experiences with and observations of their child, indicated that the score was lower than expected with demonstrated areas of what they considered mastery or proficiency.

Learning for parents was primarily in the areas of knowing that their child was fairly normal/average for their age and accomplishments. One parent stated, they “already know (their) child’s strengths and weaknesses.” Another learned “he is growing in his areas of weakness.” Another stated, “he is a normal child with strengths and weaknesses as all children are.” One parent stated that “I need to practice more writing with (their child)” and yet another, “we need to work on reading and writing.” One learned their child “is high in categories with reading and math.” One learned that “all categories should be average or above. Physicality and leadership is what I believe to be her weaknesses but she does improve on both each year. Her strengths are very strong.” Another parent thought “she did very well – she has potential in many areas” and similarly, another stated “that she is doing very well overall.”

Finally, as parents and children discussed the results, their top three strengths in which they were in agreement were the linguistic, math-logic and interpersonal
influences. In the areas of agreed weaknesses, the top three were the kinesthetic, and tied for second were the naturalist, musical and linguistic intelligences.

Though response rate was low, 77% of the parents agreed in principal that the MIDAS composite profiles as well as the individual intelligence score results were at least ‘okay’ or ‘average’ in regards to their child. As evidenced in the commentary above, parents were also thoughtful in regards to what the results demonstrated in regards to their child and what follow-up on their part may be necessary in helping their child develop their weaker intelligence strengths.

And finally, one parent writes in reflection of present realities, “This was a great way to see what my daughter’s strengths are and to see how well she does working with others and on her own” but yet another looks to the future and potential applications as she states, “Based on (his) results, what kind of learner is he? How or what kind of teaching will suit him best? Is there anything I should focus on to help him in the first grade?” These were great considerations in looking at the whole child presently yet also considering what these present realities portend for the future and individualized instructional possibilities, which is what Gardner envisioned in his Theory of Multiple Intelligences (1983).

Summary

In summary, within a mixed-methods study design that occurred during March-May 2007, 32 children were observed individually by the researcher and scored according to a Level of Interaction rubric (Labbo & Kuhn, 2000) when using the ‘Let Me Play’ version of the Stellaluna CD-ROM storybook. The numerical data obtained here
was correlated with numerical data obtained from their MIDAS/My Young Child
(Shearer, 1994; 2002) eight intelligence strength scores as obtained through MIDAS/My
Young Child profiles completed by their parents.

A Spearman rho correlational analysis was completed for each of the hypotheses
and found that minimal linear and statistically insignificant relationships existed between
six of the eight data sets. Two had minimal but statistically significant relationships.

Within the lens of triangulated qualitative and quantitative data, a case study
analysis of four student exemplars, representing students with both very high and very
low kinesthetic and spatial intelligence strength scores, provided additional information
concerning individual meaning making and potential relationships between student
responses to electronic CD-ROM storybooks and their multiple intelligence strength
scores. Three separate data analyses; that of observational data, correlational relationship
data and cross-case data were conducted and discussed.

This discussion of results provides valuable information from both quantitative
and qualitative perspectives. Correlational analyses show positive linear and statistically
significant relationships existing between combined cognitive and metacognitive levels
of interaction and intrapersonal intelligence scores and between combined cognitive and
metacognitive levels of interaction and naturalist intelligence scores. There was
demonstrated little if any discernable linear relationships existing between combined
cognitive and metacognitive levels of interaction and interpersonal intelligence scores,
between combined cognitive and metacognitive levels of interaction and kinesthetic
intelligence scores, between combined cognitive and metacognitive levels of interaction
and linguistic intelligence scores, between combined cognitive and metacognitive levels of interaction and math-logical intelligence scores between combined cognitive and metacognitive levels of interaction and musical intelligence scores and between combined cognitive and metacognitive levels of interaction and spatial intelligence scores.

Qualitative observations and discussions show a variety of approaches and masteries by the individual children observed and quite unique, though occasionally overlapping, pathways as they explored the landscape of the *Stellaluna* CD-ROM storybook. Cross-case analyses showed various patterns that appeared evident between the scores the children received in levels of interactions and intelligence profiles and specific elements of their individual explorations of the CD-ROM storybook.

These analyses pave the way for a discussion of possible interpretations and conclusions as well as potential implications that arise from a closer examination of the data.
CHAPTER V

DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

Introduction

Study Methodology and Results Summary

This mixed-methods research design attempted to explore the potential relationships between Kindergartners’ eight individual intelligence strengths and their combined cognitive and metacognitive levels of interaction with an electronic CD-ROM storybook. Blending both quantitative correlational research and a qualitative case study/participant-observer approach, this mixed-methods study became a concurrent triangulation design in which both the quantitative and qualitative data were collected simultaneously, results were merged and the two data sets combined and analyzed to present a more complete view of the phenomena under study.

There were eight hypotheses that determined to show that (1) there was a relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their interpersonal intelligence strength, (2) there was a relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their intrapersonal intelligence strength, (3) there was a relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their kinesthetic intelligence strength, (4) there was a relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their linguistic intelligence strength, (5) there was a relationship between students’...
combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their math-logical intelligence strength, (6) there was a relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their musical intelligence strength, (7) there was a relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their naturalist intelligence strength and that (8) there was a relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their spatial intelligence strength.

Inherent within the study was the expectation that participants’ individual intelligence strengths would show greater or lesser positive linear relationships in variant measures and would demonstrate differing interactions with the CD-ROM storybooks that would affect both frequency and variances in the combined cognitive and metacognitive level of interaction. It was originally perceived that the combination of visual and verbal representation of content in the CD-ROM storybooks as well as their interactive hands-on capabilities may have the capability to enhance or detract from the combined cognitive and metacognitive response of students possessing specific and selective intelligence strengths. Time sampling and frequency-count recording observations of these interactions provided not only quantitative data for the observational rubrics but also qualitative descriptions of how individual students brought meaning to the CD-ROM storybook viewing/interaction experience.
Within this mixed-methods study design that occurred during March-May 2007, 32 children were observed individually by the researcher and scored according to a Level of Interaction rubric (Labbo & Kuhn, 2000) when using the ‘Let Me Play’ version of the Stellaluna CD-ROM storybook. The numerical data obtained here was correlated with numerical data obtained from their MIDAS/My Young Child (Shearer, 1994; 2002) eight intelligence strength scores as obtained through MIDAS/My Young Child profiles completed by their parents.

Within the lens of this triangulated qualitative and quantitative data, a case study analysis of four student exemplars, representing students with both very high and very low kinesthetic and spatial intelligence strength scores, provided additional information concerning individual meaning making and potential relationships between student responses to electronic CD-ROM storybooks and their multiple intelligence strength scores. Three separate data analyses; that of observational data, correlational relationship data and cross-case data were conducted and discussed.

Correlational analyses were completed for each of the hypotheses with low significant relationships existing within two of the eight intelligences; the intrapersonal and the naturalist.

Qualitative observations and discussions revealed a variety of approaches and masteries by the individual children observed and quite unique, though occasionally overlapping, pathways as they explored the landscape of the Stellaluna CD-ROM storybook. Cross-case analyses showed various patterns that appeared evident between
the scores the children received in levels of interactions and intelligence profiles and specific elements of their individual explorations of the CD-ROM storybook.

**Organization of Conclusions and Implications Discussion**

In this chapter, I will speculate further on potential meanings for some of these data results, as well as the differing classroom environments and instructional philosophies, both singularly as well as in combination, as well as the potential for further study and investigation. Where possible divergent meanings and research directions may be present, alternative interpretations will be proposed within the parameters of the data results and existing research. Extended looks at these data results for individual exemplar students and their implications as well as their combined cross case analysis will hopefully extend possibilities for the results of this study within the broader literacy learning tableau.

This discussion will be loosely organized within the framework of the broad scope research questions which drove both the study design and resultant data analysis. Conversations and speculations surrounding the correlational relationships, exemplar students’ case study results, relationship analyses and, finally, the exemplar relationship cross-case analysis will be addressed in turn throughout this chapter.

The purpose of this study was to investigate potential relationships between students’ levels of interactions with CD-ROM storybooks and their individual multiple intelligence strengths. This study remains one empirical piece within a growing and continually evolving research puzzle. Within the course of this investigation, there were two broad research questions addressed simultaneously throughout the study.
1. What is the relationship between students’ combined cognitive and metacognitive level of interaction with electronic CD-ROM storybooks and their eight individual multiple intelligence strengths?

2. What apparent observed meaning making, from both the participant and researcher perspectives, is occurring within select participants individually as they interact with an electronic CD-ROM storybook?

Conclusions, Implications and Possible Directions for Future Research

In this section will be an overview of the individual reporting of each exemplar student observational data in relation to their combined cognitive/metacognitive interactions with the Stellaluna CD-ROM storybook. Concluding ideas provide not only interesting collaborative and individual results but also hold inherent possibilities for implications and future research directions. The overview will be integrated within groupings of some brief conclusions and possible implications of the revealed data analysis and accompanying speculations.

As we consider some specific topics in relationship to the study’s findings, there are some possible recommendations for practice within early childhood classrooms and their program of reading instruction that can facilitate and hopefully meet the needs of every child. The integrated areas of discussion and recommendation throughout will be focused on the potential applications within the areas of individualized instruction, new literacies, transmedia/multiple platforms and eye tracking software. Finally, discussions
of the relevance of the CD-ROM within the rapidly changing technology landscape and the need for their inclusion within classroom instruction will complete the chapter.

**Bringing Conclusions, Implications and Research in Focus: Individualized Instruction**

Discussions concerning the potential impact of instructional stylistic differences on student individual and profile intelligence strength growth, the dichotomies of the student exemplars possessing distinctly different intelligence strengths yet possessing an internal compass and unique intelligence profiles and, in addition, the importance of socialization and its possible influence on individual student success are three initial conclusions that have arisen from this study. These three areas may be, at first glance, very different topics for consideration when viewed in isolation. When viewed holistically, they point toward an important implication for consideration - the need to embrace the concept of individualized instruction within the early childhood classroom.

Eisner states that:

For me there is something intuitively right about recognizing that people differ in the ways in which they function best. There is something socially right about the idea that children and adolescents should be given an opportunity to shine in classrooms in which their particular strengths can be nurtured and made public. In both of these ideas, equity, educationally speaking, requires more than having the opportunity to cross the school’s threshold; it includes having the opportunities once that threshold is crossed to find a setting that is sensitive and responsive to the forms of intelligence individuals possess. (p. 33)
It is hoped that within the conclusions and implications of this study on the use of electronic CD-ROM storybooks within the classroom and the potential support that they can provide for students with various intelligence strength profiles, in combination with the thoughts of Eisner as quoted above, would be a tool in further convincing teachers of the need to include these storybooks within their reading instruction. Further,

The cognitivist’s acknowledgement of different kinds of minds opens up enormous educational opportunities. If individuals do differ from one another and if we want to reach as many of them as possible, it makes little sense to treat everyone in a one-size-fits-all manner. Rather, we need to understand the specific minds involved in an educational encounter; and insofar as possible, we should base our education, including choices of technology, on that knowledge.

(Veenema & Gardner, 1996, p. 3)

The National Reading Panel Report (2000) found “agreement in the experimental literature that computer technology can be used to deliver a variety of styles of reading instruction successfully” (p. 6-9). Specifically, one implication was that reading instruction could benefit from multimedia computer software. The Report (2000) stated that “there appear to be many students who benefit from the addition of multimedia instruction to a conventional curriculum…where multimedia software is available and appropriate, it should be exploited” (p. 6-8). Melton, Pickett and Sherer (1999) state that “a reading program based on MI (multiple intelligence) theory encourages students to learn to read in ways that make reading skills most meaningful to them” (p. 10). Teaching to a child’s intelligence strengths or unique intelligence strength profile by
providing a variety of instructional strategies in early reading instruction, instructional strategies which can include CD-ROM storybooks or other e-storybooks, may facilitate children with differentiated intelligences and intelligence profiles, such as seen within this study, in learning to read.

Denig (2004) proposes that “if we examine multiple intelligences and learning styles as different and complementary, we may be able to create a research base that demonstrates an increase in student learning across the whole spectrum of intelligences . . .” (p. 106). There is a distinct possibility that some of our students need the audio, visual and kinesthetic support that electronic CD-ROM storybooks bring to the equation. Vialle (1991) notes the importance, particularly, of Gardner’s (1983) theory for children who fall outside of the “normal” intelligences that classrooms are usually structured to support. Gardner’s (1995) belief that:

A pluralist approach opens up the possibility that students can display their new understandings – as well as their continuing difficulties – in ways that are comfortable for them and accessible to others . . . students secure a sense of what it is like to be an expert when they behold that a teacher can represent knowledge in a number of different ways. (p. 208)

Matthew (1997) sees electronic books possessing a “mixture of visual, tactile and listening modalities . . . (that) . . . enables students to learn through their preferred modality” (p. 263). Concerning the benefits of multimedia presentations in learning, Neuman (2009) posits within her theory of synergy that “given the proper mix of medium, student needs, and learning tasks, instruction may be more appropriately tailored to meet
the specific aptitudes of individual learners” (p. 45). Considering the specific individual intelligence strengths and weaknesses of the four exemplars within this study along with the strengths their individual and very personalized intelligence strength profiles brought to the reading experience, it appears evident that individualizing instruction would be a recommended and useful support for all students within the reading classroom.

**She Says Po-tay-toe and I Say Po-tah-toe - Instructional Stylistic Differences**

The rough initial data seems to indicate the potential for classroom instructional stylistic philosophy differences to affect specific student, and perhaps even classroom student intelligence growth and development. The sample Kindergarten class research sites were selected based on the researcher’s original understanding of students’ access to and experience with computer technology within their respective classroom educational environments. Homogeneity, in this regard, did exist but the researcher also, once on site, found interesting examples of heterogeneity in classroom educational philosophy and practice. The first research site’s classroom was conducted within a Reggio Emilia frame of practice and the remaining two classrooms were managed within a traditional drill and practice classroom model. Within the analysis phase, interesting trends among the data displays developed which hinted that these differences in classroom philosophy and practice could have had an effect upon the correlation results.

Though in insufficient numbers to declare a valid correlation, and requiring a larger sample to determine valid relationships; when separating out the 12 students in the Reggio Emilia classroom from the 20 students in the traditional classrooms, there appeared to be higher correlations within the kinesthetic and spatial strengths for the
Reggio students than for the traditional classroom students. When looking at the kinesthetic and spatial intelligence strengths, consistently, the Reggio class held the highest maximum, minimum and mean scores and the traditional class the lowest with the Reggio means roughly 10% higher.

Gardner’s research in multiple intelligences show that we all possess a measure of all of the intelligences but that, also, different ones of those intelligences are developed based upon the environment and experiences we have as individuals. (Gardner, 1999) The differences in classroom philosophies could have provided both the environmental and experiential differences that registered stronger intelligence development in both the kinesthetic and spatial strengths for the students within the Reggio classroom setting. More research with a larger sample of students would be necessary to further and more completely investigate this theory.

Possible research could take the form of a case study in which a sufficient sample of students within both Reggio Emilia and traditional drill and practice classrooms are garnered. The MIDAS/My Young Child (Shearer, 1994; 2002) instrument could be administered to parents of all students and resulting intelligence strength scores for all students in both types of classrooms could be compared.

The resulting data could more strongly indicate whether trends found between the students in this new research continue to demonstrate the Reggio classroom students holding higher intelligence scores in the spatial and kinesthetic strengths than students in the drill and practice classrooms. Trends could be further matched across all intelligence strengths rather than simply across only the spatial and kinesthetic strengths.
The Internal Compass . . . Unique Intelligence Profiles

Rather than individual strengths rising to the top and manifesting themselves in clear and unmistakable ways, it could be the total student intelligence profile (Gardner, 1999) which impacts most strongly the ways in which individual students approach any task, whether interacting with an electronic storybook or the way in which they approach any academic or entertainment task with which they are faced. The connection between the theme and content of the *Stellaluna* storybook, which will be discussed in more detail later, easily comes into alignment with the possibility that it could even be that the student intelligence profile as a whole, with greater and lesser intelligence strengths in unique combinations within each student exemplar, had the strongest effect in impacting the study results as revealed. Student weaknesses and strengths combine to balance learning and the ways in which students cope with new content.

As mentioned, the combination of exemplars’ individual intelligence strengths, working both independently and as a whole, could have provided an internal compass for their interactive narrative explorations both quantitatively and qualitatively (Gardner, 1999). For example, Garrett’s high intrapersonal strength personal profile subscale scores in self-management and goal achievement appeared to pair with his high kinesthetic dexterity personal subscale score to provide the drive and plan behind his physical skills to achieve a guided plan that achieved high levels of interaction within the storybook. Garrett’s very high spatial artistic personal subscale score and high constructions subscale personal score strengths may have paired with his high naturalist science personal subscale score to provide him with a connection combination to both the
visual and subject matter that made his experience a richer, more in depth one. His high math-logic strength personal subscale scores in problem solving and reasoning and his very high linguistic sensitivity strength personal subscale scores also could have played a role in their support of both the structure and form of his electronic narrative interactions.

As with Garrett, the combination of Tressa’s individual intelligence strengths within her personal profile, working both independently and as a whole (Gardner, 1999), could have provided that same internal compass for her quantitative and qualitative interactive narrative explorations. Her high intrapersonal strength personal scores in self-management and goal achievement, her high kinesthetic dexterity personal score, very high spatial artistic and high constructions personal score strengths (all three identical to those of Garrett), a high naturalist science personal profile score, very high math-logic strength personal scores in problem solving and reasoning and her very high linguistic writing strength personal profile scores potentially played a role in their support of both the structure and form of her electronic narrative interactions. Looking at these both individually and in combination as a profile may assist with the formation of an interactive narrative map of Tressa’s explorations.

Ethan’s naturalist strength, however, was his personal profile highest and with the content of Stellaluna focusing on the natural environment, this focus could have potentially played a role in his higher quantitative level of interactions in comparison with higher scoring exemplars, Garrett and Tressa. His overriding personal profile naturalist strength, in combination with moderate math-logic score personal strengths in the areas of reasoning and problem solving, moderate musical vocal personal strengths
and moderate linguistic sensitivity personal strengths could have worked in consort to
have supported both the structure and form of his electronic narrative interactions.
Looking at these factors both individually and as puzzle pieces coming together to form a
complete student intelligence profile (Gardner, 1999) could assist in forming Ethan’s
personal interactive narrative explorations.

And for the fourth time, the combination of Kenyon’s individual personal
intelligence strengths, much the same as Garrett, Tressa and Ethan before him, worked
both independently and as a whole (Gardner, 1999) to provide that same internal compass
for his interactive quantitative and qualitative narrative explorations. His moderate
intrapersonal strength personal subscale scores in self-management and goal achievement,
his moderate kinesthetic dexterity and physicality personal subscale scores, moderate
spatial constructions personal subscale score strength, moderate math-logic reasoning
strength personal subscale score and his moderate musical musicality and vocal strength
personal subscale scores potentially played a role. His intrapersonal profile scores could
be perceived as showing a measure of internal control as he interactively made his way
through the content at hand. In addition, Kenyon’s ability to self-manage, and Ethan’s as
well, combined with their high goal achievement motivation in their personal profiles
was a winning combination and support toward a higher quality interaction.

Higher scoring exemplars were able to interact interpersonally on a higher level
with the researcher and still manage the physical dexterity and metacognitive skills
necessary to navigate throughout the CD-ROM storybook in a highly successful manner.
This seems to indicate the presence of a unique intelligence strength balance and
compensation, perhaps much akin to that alluded to within the discussion surrounding the spatial intelligence results.

Though student exemplar strengths were lower than expected in the kinesthetic area, their levels of combined interaction with the storybook remained higher than would be expected. The level of lower scoring exemplars Ethan and Kenyon’s interpersonal interaction and conversation with the researcher and about the storybook, though present, was not at the same level as that of higher scoring exemplars Garrett and Tressa, but the approach was more of a ‘just the facts ma’am’ model, with activity on screen the primary focus and conversation about such secondary. This is also in agreement with the lower interpersonal intelligence strength personal profile scores for these two exemplars as shown in Table 6. There appeared to be a parallel factor at work within the lower scoring exemplars’ kinesthetic scores to balance and keep interactions at a comparably high level to those of the higher scoring exemplars. It also appeared that level of interaction scores might have a tendency to peak with students possessing both high and low kinesthetic strengths.

Individual exemplars’ uniquely dramatic approaches to the story, as supported by moderate musical and kinesthetic personal profile strengths, could also have facilitated both the structure and form of electronic narrative interactions. The absence of strong interpersonal skills within the personal profiles of the lower scoring exemplars resulted in a comparably lower level of engaged conversation with the researcher during their time with the *Stellaluna* storybook, but also potentially could have elevated their level of interaction scores with their more singular focus.
It was also clear that there was a linear correlation at work within the data display for the intrapersonal intelligence. What is interesting here, however, is that exemplars with both higher and lower intrapersonal intelligence personal profile strengths maintained comparable levels of interaction with the *Stellaluna* CD-ROM storybook, as shown in Table 15. But again, concluding evidence shows that there were other mitigating strengths within the lower scoring exemplars’ intelligence profile as a whole that appeared to help these students experience a comparable level of interaction to that of the higher scoring exemplars. So strongly present within the two highest scoring exemplars, however, were strong intrapersonal subscale personal profile strengths in the areas of self-management and goal achievement and these were notably absent in lower scoring exemplars.

What is interesting here, and may show evidence of a variant relationship of sorts in action, is that both Kenyon and Ethan, the lower scoring exemplars, with much lower artistic subscale scores in their kinesthetic and spatial intelligence personal profile strengths, also experienced total combined cognitive and metacognitive scores over 100, with higher metacognitive than cognitive interactions, and also engaged in predicting and confirming behaviors as well as strategic access of the media effects. Among the exemplars, students at the lower end of the spatial intelligence spectrum had a level of interaction very similar to those with higher spatial intelligence personal profile scores.

In exploring the latter thought, consider that Ethan scored lowest in spatial yet his highest personal profile intelligence was the naturalist. Here it appears that the content and theme of the *Stellaluna* storybook also could have engaged his naturalistic strengths.
and buoyed the flagging spatial to bring the equation into more of a balance with his fellow exemplars who scored much higher in this area. Kenyon’s spatial score was his sixth highest within his personal profile, but his kinesthetic was his highest intelligence strength within his MIDAS/My Young Child personal profile. In this case the interactive component of the CD-ROM storybook and his kinesthetic strength could have worked in unison to bolster his flagging spatial strengths.

Specific connections individual exemplars made within the story had an uncanny relationship to the naturalist intelligence score within their personal profiles. Both Ethan and Kenyon, the lower scoring exemplars, had the naturalist intelligence strength as their personal profiles’ highest. These naturalist strengths could have compensated and elevated their combined cognitive and metacognitive interactions to be comparable to those of Garrett and Tressa, the higher scoring exemplars. The naturalist intelligence hosts three subscales; animal care, plants and science. Exemplar students’ scores for each are reflected in Table 11. Three of the four exemplars scored in the high moderate to very high in animal care and moderate to very high in science within their personal profile scores. The naturalist intelligence also ranked as the highest intelligence within the personal profiles for the two lower scoring exemplars and second and third highest for the two higher scoring exemplars. Across the sample the personal profile naturalist strengths were strong and this appeared to favorably affect the higher levels of interaction with the storybook that all students enjoyed.

When student strengths and concurrent correlational relationships are not as evident in the personal spatial and kinesthetic strengths’ scores, for example, as predicted
by the researcher, or for any other personal profile intelligence strengths for that matter, there appear to be other personal strengths present that rise to the occasion and which perhaps shore up and balance the weaknesses in the strengths under examination and analysis.

If not here, there may be some unique combination of intelligence strengths in the two lower scoring exemplars that could explain their competitive levels of combined cognitive and metacognitive interactions with the CD-ROM storybook in comparison to their higher scoring peer exemplars. There appears to be quite relevant strengths in both Ethan and Kenyon that could perhaps compensate their lower personal profile spatial strengths and keep them interacting with the electronic storybook at comparable levels to those of Garrett and Tressa, the higher scoring exemplars.

All four student exemplars demonstrated the likelihood that a combination of their personal individual intelligence strengths, working as a unified and integrated whole, acted as an internal compass for their narrative explorations. This holistic interactivity appeared to manifest itself in a unique intelligence profile for each exemplar that, though different for each, worked seamlessly to provide maximal results in the levels of interaction with the electronic CD-ROM storybook.
It’s All About Others . . . The Importance of Social Interaction

Part of the reason for a relatively non-existent interpersonal correlational relationship for all exemplars could be due to the lack of opportunity for socialization while interacting with the CD-ROM storybook. Exemplar observations were individualized and conducted in a separate space, isolated from the other classroom children.

Computer use among young children has shown to be often times a very social activity (Leu & Kinzer, 2003) and this was observed by the researcher during whole classroom observations. Students would often work in groups offering insight and suggestions based on their personal skills and acuity with the various software packages as well as their past experiences and problem solving opportunities when at the classroom computer stations.

Within this individualized research setting, student exemplars were virtually on their own as they trailblazed and traversed their own unique pathways and interactions throughout the Stellaluna storybook. Their interpersonal subscale personal profile scores of leadership, understanding people and getting along with others, as reflected in Table 12, did not really have an opportunity to come into play and affect their levels of interaction with the CD-ROM storybook other than their abilities and skills within interactions with the researcher present during the observations.

Bringing Conclusions, Implications and Research in Focus: New Literacies

Discussions concerning the potential impact of dual coding theory at work within the results of student interactions with the CD-ROM storybook and multiple unique paths
to literacy that the student exemplars demonstrated are two additional conclusions that have arisen from this study. These two areas can be perceived as different in themselves but share similarities when considered holistically. They share strengths as they point toward another important implication for consideration - the need to embrace the concept of new literacies within the early childhood classroom.

Reading experts (Adams, 1986 cited in Chu, 1995; Balajthy, 1988 cited in Chu; 1995; Bus, Verhallen & deJong, 2009; Matthew, 1996; McKenna, 1998; Miller, Blackstock & Miller, 1994; Neuman, 2009) are arguing that technology is particularly critical for an increasing percentage of our population who don’t respond well to traditional print media and who are either reluctant readers or language challenged. Rather than considering reading in exclusive terms of a print-based literacy, one needs to look at reading much more expansively and inclusively, as occurring within any meaning-making process and within any kind of sign system text. Neuman (2009), in her theory of synergy, argues that “each medium employs specific symbols to tell a story and structures how individuals process and acquire information” (p. 46). Berghoff (1998) considers that:

Thinking of ‘reading’ as a process that cuts across sign systems is parallel in many ways to the manner in which authoring is changing. Technological developments now allow us to create texts in visual images, sound bites, music, video clips and animation, as well as the written word. To survive in this complexity, learners have to have control of the cognitive processes that cut across sign systems – the processes that... have (been) valued in language
arts – reading, authoring, inquiry – need to be developed as the ability to work flexibly across all sign systems. (p. 522)

Electronic CD-ROM storybooks veritably cut across sign systems in their multimedia presentation of story. Many readers do not thrive in an exclusively print-based literacy environment for a variety of reasons. For some children, their intelligence strengths are ones that thrive in an environment similar to the one Berghoff (1998) describes rather than within the reality of their classroom experience. Their ability, in fact their potential need, to traverse across these multiple sign systems can be facilitated by experiencing story via interactive CD-ROM storybooks. Neuman (2009) argues within her theory of synergy that “multimedia presentations have the potential to be more powerful interventions especially for children who are at risk – than a single medium alone” (p. 45).

In her study, Baker (2000) found that students operating in both visual and auditory modalities used multiple sign systems in consort and interchangeably within their construction of various literacy activities. Students used text, graphics, animations, video and audio to represent content within the various activities. Baker concluded that

Theories of semiotics, multiple sign systems and modalities help us examine not only young children’s literacy development, but also older children’s literacy development . . . Elementary teachers may need to cease isolating literacy into separate content areas . . . because this is not representative of how our society thinks and reasons in our increasingly technological environment. A second implication is that technology may provide a bridge between literacy which
occurs in our society and literacy education which needs to occur in our schools.

(p. 107)

In consideration of the work of Baker (2000) and citing that of Reinking (1995) and Labbo (1996), Kinzer and Leu (1997) recognize, as well, that “we are entering a period where traditional definitions of literacy will need to be evaluated for their appropriateness within electronic environments” (p. 134). This recognition involves the consideration of the many new electronic tools of learning at our disposal and the need to incorporate these within classroom literacy environments and activities.

In Gee’s (2003) look at the connections between video games, literacy and learning, he takes us a bit further into the new literacy journey in his exploration of the parallels found and recognized between children’s real world experiences with literacies and those literacy experiences of the classroom. Gee sees video games as one of many literacies and states that “once we see this multiplicity of literacy (literacies), we realize that when we think about reading and writing, we have to think beyond print” (p. 14). He sees video games as examples of “multimodal texts (texts that mix words and images) . . . images often communicate different things from the words. And the combination of the two modes communicates things that neither of the modes does separately” (p. 14). Further, Gee (2003) views current thinking of literacy as primarily a print-based domain as faulty and advocates the consideration of semiotic domains.

If we think first in terms of semiotic domains and not in terms of reading and writing as traditionally conceived, we can say that people are (or are not) literate
(partially or fully) in a domain if they can recognize (the equivalent of ‘reading’) . . . meanings in the domain. (p. 18)

CD-ROM storybooks and newer generation e-storybooks, as well as the video games of which Gee (2003) speaks, are semiotic domains that demand a new consideration of literacy, particularly for those whose primary literary functioning is one in these multimodal worlds. Including storybooks in alternative electronic formats within classroom instruction facilitates and supports children, and their subsequent learning, who operate more comfortably and successfully in one of these alternative semiotic domains. Neuman (2009) takes this a step further and brings into consideration schema theory as she states that “regardless of the medium, children actively search for meaning, they strategically examine and attend to certain features of the medium, they construct and interpret meaning, and they use their prior knowledge in acquiring meaning and making inferences…(and finds in her research)…that the interpretive processes of ‘viewing’ stories were strikingly similar to that of ‘reading’ stories” (p. 49).

Electronic CD-ROM storybooks, as well as other electronic means of presenting story, are uniquely positioned to stand in the gap between traditional print-based literacy and multiple/new literacies in their multimodal presentation of story. Larson (2010) found that “e-books in general, and digital readers in particular, have the potential to unveil an array of new teaching and learning possibilities as traditional and new literacy skills are integrated in meaningful ways” (p. 21). Electronic storybooks have the capability to share verbal and visual content concurrently within their screen environments and hold inherent applications to the findings of Mayer and Sims (1994) in
their dual-coding theory of multimedia learning. Mayer and Sims (1994) found that what was most beneficial for students with high spatial abilities was a very similar concurrent presentation of verbal and visual content. Electronic storybooks support new literacies and students’ unique and multiple paths to literacy within 21st century classrooms.

**Dual Coding Theory at Work**

High level of responses to *Stellaluna* appears to exemplify the tenets found in dual coding theory. This theory explains “psychological phenomena by the collective action of nonverbal and verbal mental systems that are specialized for the processing of imagery and linguistic information” (Clark & Paivio, 1991, p. 150). In support of this, Leu (2000) states that multimodal learning theories, such as the dual coding theory of Paivio, typically suggest that information presented within multiple modalities maximizes learning for a wider variety of students, some of whom optimize information presented within a verbal context and others who optimize information presented within an imaginal (visual) context. (p. 752)

The pairing of images and text has been found to have a positive learning effect on students, particularly those with high spatial abilities, such as Garrett (Shah and Freedman, 2003). Mayer and Sims (1994) proposed a dual coding theory of multimedia learning that suggests that learning occurs “when students use information presented in two or more formats – such as a visually presented animation and verbally presented narration – to construct knowledge” (p. 389-390). Neuman (2009) corroborates the claims of dual coding theory within her theory of synergy, “the first premise of . . .
(which) . . . is that instructional messages from media differ qualitatively” (p. 47) within presentation modes as well as within processing demands and that “media that allow children to ‘click here to continue’, controlling the presentation pace, have been shown in preliminary research studies to result in better transfer performance” (p. 48).

Though the spatial constructions subscale score, as represented in Table 9, may not hold as strong a relationship to interactions with the storybooks, a child’s spatial artistic subscale score, indicating their heightened awareness of and skill with navigating the multiple visual dynamics of the physical tableau of the CDROM storybook could be much more telling. Both Garrett and Tressa’s artistic subscale scores ranked at 100%. This could also hold possible explanations within a dual coding theory of multimedia learning (Mayer & Sims, 1994) where the simultaneous animated presentation of visual and verbal content has the potential to facilitate the construction of knowledge for learners that possess high spatial ability.

In addition, when considering the lower scoring exemplars, it could be possible that students who have lower spatial scores could be working much harder to stay in focus with the storybook action and expend their efforts and energies in engaging with the story at hand. There could also be other strengths they possessed which blended and bolstered the spatial strengths, as discussed within the section on student intelligence profiles, and resulted in higher levels of interaction than might be expected in relation to their spatial scores.
Multiple Unique Paths to Literacy

Each of the student exemplars demonstrated a uniquely integrated multimedia enjoyment of the semiotic domain that is *Stellaluna*. Semiotics provides a framework within which the conception of literacy is extended “from only the reading and writing of printed materials to include literacy as a multimedia, computer-based composition” (Labbo, 1996, p. 359). The symbol systems available to young children today in their meaning-making processes, and many found within *Stellaluna*, include not only traditional oral language and print, but also music, art, icons, scanned images and other varieties of electronic symbols. In considering previous discussions and research cited within this study, it once again becomes easier to nod in agreement with Labbo and Kuhn (1998) when they note the “possibility that children who have consistent access to electronic symbol making might chart a unique path to literacy, or might follow multiple electronic paths to conventional literacy” (p. 82). These paths to literacy could involve the use of electronic CD-ROM storybooks as bridges from the unique to the more conventional paths of which Labbo and Kuhn (1998) speak. Fisch et al (2002) showed that the same kinds of meaningful interactions about text can occur within electronic environments as questioning strategies and interactions help the child communicate with text and story in similar ways. Though some exemplars’ dramatic, thoughtful and measured approaches were qualitatively different than the other exemplars, these personal approaches empowered them as readers and, when present, unique physical involvement with the story resulted in a full experience of the interactive narrative elements at hand.
As we evaluate the experiences of the exemplars in total, it may be helpful to consider the concept of multiple literacies and the role that it plays with incorporating the use of electronic CD-ROM storybooks within reading instruction. Turbill’s (2001) research found an interesting parallel between Clay’s (1979) Concepts of Print and what Turbill (2001) coined as Concepts of Screen. Turbill’s (2001) concern that Kindergarten teachers were using too limited a definition of literacy came through clearly in her results as she commented that “the children’s…reading of the visuals (in the electronic CD-ROM storybooks) and their discussions around these may not have been different from what we might expect of book-based reading of the illustrations, but the children were creating meaning from these visuals and animations. This form of reading need(s) to be incorporated into both the teacher’s definition of reading and her classroom practice” (p. 275). This closely falls into alignment with Neuman’s (2009) theory of synergy and application of schema theory therein. Within this study, the four exemplars were busy in reading visuals, discussing such and creating meaning throughout their individual and corporate explorations of the Stellaluna CD-ROM storybook.

Electronic CD-ROM storybook technology is an example of one of the technologies mentioned in Sweeder, Bednar and Ryan’s (1998) claim that “product technologies are natural components to MI (multiple intelligence) theory because they enable learners to access and ply more readily their natural learning styles or preferences which…emanates from one or more of their personal intelligences . . . by conjoining MI (multiple intelligence) theory with a variety of product technologies, we believe that we are more likely to engage our students and assist them in comprehending course content”
Veenema and Gardner (1996) echo this sentiment in their thought that “if we believe that the mind is neither singular nor revealed in a single language of representation, our use of technologies should reflect that understanding . . . technologies like CD-ROM that include a variety of media may well be able to help more students form rich representations…and cultivate deeper understandings” (p. 6-7). The evidence of these rich representations and deeper understandings appeared to proliferate qualitatively within the exemplars’ interactions with the Stellaluna CD-ROM storybook.

**Bringing Conclusions, Implications and Research in Focus: Transmedia/Multiple Platforms**

Discussions concerning the potential impact of teacher coach/facilitation within the results of student interactions with the CD-ROM storybook, the role of individual reader response to multiple formats of story and the possible influence of story content upon student interactions with an electronic CD-ROM storybook are three additional conclusions that have arisen from this study. Two of these three areas appear to share some similarities but all work in an integrated fashion as they collaborate efforts and point toward another important implication for consideration - the need to embrace and equate the concept of story across multiple platforms and media within the early childhood classroom.

As mentioned previously, Matthew (1997) sees electronic books possessing a “mixture of visual, tactile and listening modalities . . . (that) . . . enables students to learn through their preferred modality” (p. 263). Her research measured student comprehension and involved the use of both the same print and electronic storybooks
with students. Some students read print only, some electronic only and others read both the print and electronic storybooks. Results showed that comprehension was at its highest in the group of students that used both the same print and electronic storybooks in partnership with each other. Matthew (1997) concluded that “using both electronic and print texts as complements to each other facilitates the different learning styles found in classrooms” (p. 272).

Kist (2000) cites Vygotsky, (1934/1986) as he discusses that the sign system choices that individuals make are influenced by early childhood experiences as well as by our culture and history; in a sense by the cognitive apprenticeships that are formed. Young children today are surrounded by computers and electronic communication and delivery devices, including electronic CD-ROM storybooks, storybook apps on touch screens, e-storybooks and storybooks in audio, video and print formats. Today, and even moreso as when they grow older, this transmedia, multiplatform availability and presentation of narrative/story are rife with sign systems and multiple literacies that blend text, graphical image, sound and animated interactivity. Becoming familiar with and integrating this transmedia multiplatform approach to story within literacy instruction is a responsibility of early literacy educators. As Neuman (2009) discusses her theory of synergy in relation to multimedia presentations in learning she states, “just as children are exposed to a steady diet of genres and levels of reality and fantasy in reading, so too, should they be exposed to stories in a variety of media presentations . . . (which) . . . may enrich children’s understanding of stories and events, and extend their engagement in
literacy practices and literacy learning” (p. 55). This phenomenon will most likely continue to grow and thrive exponentially as we move into the future.

**We All Need Somebody to Lean On – The Importance of Teacher as Coach/Facilitator When Using Multimodal Texts**

Though the level and quality of student interactions with the *Stellaluna* CD-ROM storybook were rich and meaningful for each exemplar, having a teacher alongside as coach/facilitator of these student interactions could have potentially resulted in even richer and more meaningful explorations. Based on individual student observations during the course of their research, Miller, Blackstock and Miller (1994) strongly recommended that optimal use of and results with CD-ROM storybooks within the reading curriculum would occur only when teachers participate in the process and at least occasionally monitor the child’s online reading to determine traits observed as well as strategies for future instruction based on the child’s individual needs. Neuman (2009) concurs as she posits that “what children take away from multiple media, how they use it, and how literate they become from it, are shaped to a large extent by how media are mediated – by the parent, caregiver and teacher” (p. 54). CD-ROM storybooks can be important partners in reading instruction, but still require the skill and direction of teachers to maximize their effectiveness. Teacher interaction with *Stellaluna* and the students could have directed student attention to textual elements and maximized these opportunities within classroom reading instruction. When CD-ROM storybooks are used in isolation without this benefit, the potential gains will be minimized. As Medwell (1996) states, “Computers are not going to take over the teaching of reading and cannot
replace the diagnostic and remedial flexibility of a teacher reading with a young child, but they may be another way to offer beginning readers some useful extra support” (p. 46).

Part of the reason for a low correlational relationship in the spatial intelligence could be due to the children’s lack of familiarity with responding to electronic text in this way without teacher prompting and could support the notion that having the teacher as a coach/facilitator alongside children in their use of CD-ROM storybooks could enhance their cognitive level of interaction with these electronic texts. (van den Broek et al, 2009; Bus et al, 2009; Matthew, 1997; McKenna & Zucker, 2009; Neuman, 2009). The spatial intelligence strength scores could also possibly be seen in a low positive relationship here due to the distractions of the interactive hot-spots and their potential ability to steer children, without teacher support and intervention, (Trushell, Burrell & Maitland, 2001) away from verbalizing their actions and simply interacting visually and physically with the text via these features that proliferate throughout the illustrations and text.

In regards to linguistic strengths, only one of the exemplar children spent any time clicking on the on-screen text. Part of the reason for the low linguistic correlational relationships could be due to the children’s lack of familiarity with responding to electronic text in this way without teacher prompting and, as mentioned previously, could support the notion that having the teacher as a coach/facilitator alongside children in their use of CD-ROM storybooks could enhance their cognitive level of interaction with these electronic texts. (Matthew, 1997) Research continues to show the importance of teacher as scaffolder in the use of the newer computer technology applications (Reinking &
Bridwell-Bowles, 1991; National Reading Panel, 2000). The interactive hot-spots, features that proliferate throughout the illustrations and text, when perceived as distractions, have the potential ability to steer children, without teacher support and intervention, away from verbalizing their actions and simply interacting visually and physically with the visual and oral features of the story, possibly, to the exclusion of the textual components. (Trushell, Burrell and Maitland, 2001)

**Read It Again, Please . . . Reader Response When Using Multimodal Texts**

It appeared that the combination of verbal and visual representations of content and the interactive hands-on capabilities were enhancing student exemplar response to the CD-ROM storybook. Chu (1995) and James (1999) found similarly that electronic CD-ROM storybooks, by virtue of their interactivity and design, encouraged active reader response from their study participants. Likewise, exemplars made frequent predictions and confirmations of actions to come. They were empowered through the CD-ROM storybook’s representations and enhanced capabilities to engage in very personalized levels of story creation and in-depth interactions through the pathways they chose and the interactions they took advantage of and pursued.

Student exemplars took full and robust advantage of the opportunity to explore the different interactive pathways of the electronic narrative, delving deeper within the story present before them. This deeper investigation also involved exploration of and connection to *Stellaluna* in book and DVD formats, in addition to that of the CD-ROM storybook. Individual exemplar experiences with the multiple platforms of the *Stellaluna* storybook varied in their connectivity among the four exemplar children and, when
present, this enhanced connection with the print text and the associated comparisons between formats could also account for lower level of interaction numbers.

In Swan and Meskill’s (1996, 1998) research, the interactive capabilities inherent within the CD-ROM storybook were demonstrated to have positive influences on a child’s response to and connection with story. Another interesting finding was that a child’s connections with the interactive storybooks often increased motivation for connecting with the print versions, as evidenced in some exemplar experiences of the storybooks and making comparisons with its CD-ROM counterpart.

Bangert-Drowns and Pyke (2001) drew upon the literary response theories of Louise Rosenblatt, J.A. Langer and others to define what they considered to be “literate thinking”, an employment of higher level thought processes that facilitate evaluation and interpretations of text as well as an employment of multiple perspectives in both response to text and in making personal connections with and applications to the text. They hypothesized that literate thinking and engagement of text would go hand in hand, with their definition of engagement as “the mobilization of cognitive, affective and motivational strategies for interpretive transactions with text” (p. 215). The results of their study led Bangert-Drowns and Pyke (2001) to consider that “perhaps literate thinking is more common . . . with narrative software” (p. 226) such as the Stellaluna CD-ROM storybook. Though physical engagement appeared at a high level among all exemplars, as evidenced observationally by the researcher, literate thinking is more embedded and could have been occurring at different levels among the four.
Larson (2010) also drew upon the reader response research and theory of Rosenblatt in her study of newer generation Kindle e-readers and second graders. She found that the ‘digital note tool offered insights into the reader’s meaning making process as the text unfolded and served as a conduit to ongoing response writing’ (p. 17). Her students focused on response in the categories of story understanding, personal meaning making, questing, answering and response to text features and literary evaluation.

In reflection upon the practical nature and combination of fine motor skills, interactivity and reader response, it may be noteworthy to consider the impact of the kinesthetic intelligence and subscale scores. Kinesthetic intelligence strengths were further broken down into two subscales that indicated a child’s physicality and dexterity. These subscale scores might more insightfully indicate their potential skill and flexibility with navigating the CDROM storybook.

In consideration of data results, it could be interpreted that when a child has mastered the dexterity needed to interact with CD-ROM storybooks effortlessly, such as did the higher scoring exemplars Garrett and Tressa as reflected within Table 10, the energies that would normally lean toward physical mastery of interactions can be diverted to interacting with the storybook at a higher combined cognitive and metacognitive level. When energies aren’t needed to consider clicks on interactive hot-spots, they can be used to verbalize experience and commentary on the story elements on-screen and thereby possibly experience a higher level of combined cognitive and metacognitive interaction. Children might then experience story on a deeper level and comment as they think about what’s happening within the story itself rather than simply the effort involved in
navigation and attending to what’s happening on-screen. With a higher combined cognitive and metacognitive level of interaction, the story can move from a position of being a somewhat uni-dimensional aspect of the CD-ROM storybook experience to a more multi-dimensional one.

**It’s All About the Story . . . Importance of Content When Using Multimodal Texts**

The *Stellaluna* storybook’s theme dealt with animals, plants and natural habitats and possessed a scientific parallel throughout. It is interpreted that this could have had an impact on the relationship results represented within this study. Once again, an examination of student level of engagement with the storybook comes to the forefront here as we consider Bangert-Drowns and Pyke’s (2001) study and their definition of engagement as “the mobilization of cognitive, affective and motivational strategies for interpretive transactions with text” (p. 215). This easily comes into alignment with the possibility that student interest in and engagement with the predominant subject matter at hand within the storybook could have an impact on their level of interaction with the various electronic storybook elements. It is interesting to consider that not only the CD-ROM as an electronic story format but also, in consort, potentially the content, theme and topic of the storybook in relation to the students interacting and possible engagement with such, may have relevance in relation to the strength and significance of the relationship between the level of interactions with the storybook and their particular and individual intelligence strengths.

For example, three of the exemplar children’s naturalist intelligence strengths ranked as either their highest or second highest overall. The connection between the
theme and content of the *Stellaluna* storybook with their highest intelligence strength scores and its possible ability to mitigate and balance their lower scores in the kinesthetic may be an active element to be considered here. Lower scoring exemplars’ naturalist strengths were their highest and strongest across the subscales. In consideration of the content of *Stellaluna* focusing on the natural environment with an emphasis in all three of their subscale strengths, this strategic combination appeared to play a role in their higher quantitative level of interactions in comparison with the higher scoring exemplars.

In relationship to strong showings of naturalist intelligence strengths among lower scoring exemplars, in particular, the motivation to interact with the storybook based on their personal and intrinsic interest in animals and science, as demonstrated within these subscale scores of the naturalist intelligence, as seen in Table 11, could be a root cause for relationship trends being evident both within this small exemplar group as well as within the sample as a whole. Potentially the low exemplars’ strong representation in the naturalist intelligence strength perhaps combined with the topic and theme of the *Stellaluna* storybook, immersed in that of animals, plants and natural habitats/science, worked in consort with their other intelligence strengths to place them on a more even playing field, in terms of their combined cognitive and metacognitive interactions, with the two highest scoring exemplars, Garrett and Tressa.

**Bringing Conclusions, Implications and Research in Focus: Eye Tracking Software**

Discussions concerning the personal life connections made by the individual reader within their interactions with an electronic CD-ROM storybook and their distinct
personal plans for story navigation and exploration within this electronic narrative environment are two final conclusions that have arisen from this study. Both of these areas focus on personalization of the experience and distinct interpretations and pathways followed within the CD-ROM storybook. The opportunity to more clearly determine and synchronize age level consistencies in approach to electronic narratives and its potential toward fostering excellence in developmentally appropriate practice in software design points toward another important implication for consideration - the need to encourage the use of eye tracking software within student use of electronic narrative software research; one that ultimately benefits students and instructional practice within the early childhood classroom.

This is an intriguing area that holds much potential for future research in how children approach and explore story within screen environments. Current eye tracking software follows eye movements and activity within screen environments and produces heat maps of student activity on-screen. “Eye tracking provides insights in the allocation of visual attention, (and for that reason) . . . is very suited to study differences in attentional processes evoked by different types of multimedia and multi-representational learning materials” (vanGog & Scheiter, 2010, p. 95). Evans, Roy-Charland & Saint-Aubin (2009) agree as they “dangle the possibility of applying eye tracking methodology in the future to young children interacting with electronic books as a window on their cognitive engagement” (p. 106). Further, the use of eye tracking can not only see what students are attending to visually on screen, but also the time they spend on specific material and in what sequence they view such. Eye tracking also falls clearly in

**It’s All About Me . . . Personal Life Connections to Story**

In addition to exemplars making frequent predictions and confirmations of actions to come, they also made noteworthy personal life connections. Some exemplar interactions with *Stellaluna* were bathed in rich conversation and connections with realities in exemplars’ daily lives. In some instances, however, these qualitatively rich and constant conversations, questions, personal life connections and easy repartee with the researcher could have had a negative quantitative impact and resulted in a lower interactive ranking among the exemplars.

Some exemplars, more than others, found it an apparently easy task to integrate their personal life experiences within the story exploration and, while doing so, bathed that process within a conversational strand that empowered them to make *Stellaluna* a part of their personal story, becoming both simultaneous interactive reader and writer. When this occurred, activity in this regard empowered exemplars to personalize their electronic explorations. As a result, exemplars’ time with the *Stellaluna* CD-ROM storybook, though uniquely different, also became for each a deeper, richer experience of the interactive narrative elements at hand.

**I Did It My Way . . . Personal Plans for Story Exploration/Navigation**

At varying speeds of approach, student exemplars all eventually took strong advantage of the opportunity to explore the different interactive pathways of the electronic narrative and dove deep within the story before them. All exemplars appeared
to have an unspoken plan for their story exploration that empowered them as readers and also allowed a full, though occasionally repetitive, experience of the interactive narrative elements at hand.

The metacognitive component of the interaction with the CD-ROM storybooks and its strong connection with the need for students’ to be aware of their actions and plans as they became co-creators and tellers of the story could explain the stronger and significant showing in the correlation between the intrapersonal intelligence and the levels of interaction. All of the exemplars, though different, appeared to have a distinct plan for their exploration of Stellaluna CD-ROM storybook. It also became clear that it was their personal subscale scores in self-management and goal achievement Table 11, in particular, with higher scoring exemplars’, Garrett and Tressa’s, scores very high in these areas and lower scoring exemplars Ethan and Kenyon’s moderate to low, coming to bear on the results.

The math-logical intelligence is of note even though there was not a significant linear correlation with the levels of interaction with the storybook. In fact, the level of consistency in both the personal subscales of reasoning and problem solving for all exemplars could indicate that individual student strengths in these areas facilitated their frequent successful navigation of the storybook as well as heightened their level of interaction within such.

For consideration as we explore the intelligences’ impact upon individual narrative pathways, three of the four exemplar students scored 50% and above in the math-logical problem-solving personal subscales as depicted in Table 9. Another
consistency among the four exemplars within the math-logical intelligence is the strength they hold in the reasoning subscale. Reasoning was used consistently, though in different measures, by all exemplars as they chose particular pathways and approaches to their multimedia explorations. The interactive hot-spots – within the media effects - involve a good deal of reasoning and problem solving in the visual, interactive realm. A variety of reasoning skills are helpful in successfully navigating through the storybook and these are represented within the mathematical-logical intelligence. All but one exemplar scored moderate to very high in problem solving within their personal MIDAS/My Young Child profiles.

In fact, two of the exemplars’ math-logical intelligence score was their second to third highest personal intelligence scores of the eight. This was true for one of the higher scoring and also one of the lower scoring exemplars. As seen in Table 18, the higher exemplars scored high and very high in their personal memorization/learning subscales and their problem solving and reasoning subscales. The two lower scoring exemplars had low to moderate personal subscale scores in the problem solving, memorization/learning and reasoning subscales. All exemplars had at least moderate benchmark strengths in the various personal subscales and, in particular, their reasoning, memorization and learning and problem solving scores. These areas could all have played an integral role in the exemplar students’ respective levels of interaction with the CD-ROM storybook. Each of these, in their own fashion, could contribute skills for exemplar students’ successful navigation through the interactive narrative before them.
But Are They Still Really Relevant?

Many of the conventions and potential reading/literacy supports found within the older generation CD-ROM storybooks have been transferred into the newer e-books/storybooks for children. All of these devices/media offer texts enlivened by animation, sound and graphics. These texts are often highlighted in both the ‘Read To Me’ and ‘Play With Me’ versions and, as such, help children track the words visually from left to right and top to bottom as they’re read. The findings within this study continue to support the idea that electronic storybooks and their similar conventions within newer, and more enhanced, generation devices still can be found to play an integral role in facilitating both literacy as well as language learning in general when integrated within many reading instruction strategies used within the early childhood classroom. Newer generation e-reading devices, along with their older precursor CD-ROM storybooks, continue to provide early listening, reading and interactive literacy experiences that can assist children in developing the skills and interest that can make them motivated and engaged readers. In addition, multimedia storybooks, both newer and older generation, have the potential to be sensitive and responsive to children who may learn differently.

In fact researchers (Shamir & Korat, 2009; Labbo, 2009; Bus, Verhallen & DeJong, 2009; Neuman, 2009) are beginning to use the term eBook as a referent that constitutes not only the variety of technologies available today which present storybooks electronically but also as a referent to the research of the past which was focused solely on the CD-ROM storybook technology. One group of these researchers, Shamir & Korat
(2009), consider these eBooks in their various forms as integral literacy learning tools within the early childhood classroom.

In 2000, Labbo & Kuhn stated that “more research is needed on children’s meaning-making strategies when the content and structure of CD-ROM talking book stories are viewed as a unique digital genre” (p. 206). Fast forward to 2011 and we still find that with the advent of a variety of e-reading devices and technologies that research is still at a dearth in this area. Many cited within this study continue to call for additional research in this area (Bus, Verhallen & deJong (2009); Labbo (2009); Larson (2010); McKenna & Zucker (2009); Neuman (2009)). Wood, Littleton & Chera (2005) posit the potential of computer software to facilitate learning in the classroom (in areas such as motivation to read, attitudes toward reading, word reading, phonological awareness and reading comprehension” (p. 136). Finally, Herron (2011) recognizes that “mobile devices offer amazing tools for designing elegant instruction…these tools could help raise the literacy and even the I.Q.’s of the entire nation if they were thoughtfully used” (p. 5). So, the final implication to be considered is why educators should make room for these electronic tools within the classroom and some suggestions for how they might be used to support literacy instruction

How Can We Squeeze One More Thing Into the School Day . . . and Why Should We?

With the continued increase in and diversification of e-reader technologies and their potential impact upon and benefit toward the literacy development of individual students within 21st century classrooms, it is becoming ever clearer that effective and
relevant instructional strategies within these classrooms will need to successfully and meaningfully integrate these technologies within the larger literacy instructional tableau. “The digital divide in particular and the digital future in general are becoming increasingly important issues to consider in the earliest stages of literacy learning . . . it is necessary to consider the skills that . . . children will be bringing to school as well” (Barone, 2005, p. 108). Larson (2010) concurs as she calls upon us to recognize “an urgent need for teachers and researchers to address the discrepancy between the types of literacy experiences students encounter at school and those they practice in their daily lives outside the school environment” (p. 16) It becomes an issue of respect and relevancy in the eyes of our students.

There exists a continuum of sorts within the minds of educators today with traditional instructional strategies, whether that be the hard copy book or pencil and paper, etc on one end and technological innovations on the far opposite. Rather than being an either or proposition, as Blagojevic (2011) below states, blending the best of both worlds finds truth for most students and serves their best interests at different places along the mid-section of this continuum. One does not have to exist to the exclusion of the other; one is not anathema while the other all knowing and exceptional.

Bus & Neuman (2009) propose four large areas in which multimedia can support literacy instruction; (1) as facilitators of basic reading skills, (2) the importance of learning from multiple channels, (3) providing scaffolding of a different form and (4) the digital divide. I’ll discuss each of these in turn.
In considering the role of multimedia digital tools as facilitators of basic reading skills, electronic storybooks can also provide support for both decoding and comprehension, key areas within early literacy learning and development. McKenna & Zucker (2009) discuss that in regards to decoding support, use of digital pronunciation tools can assist both struggling as well as more proficient readers as they can be accessed and utilized in differing ways. “Electronic decoding supports may not only serve as a compensatory mechanism, but may also increase students’ word recognition skills . . . (as well as ) . . . more proficient readers (using) the digital pronunciation tool (for) fine tuning voice intonation and expression based on the computer’s model” (p. 259).

In their research with multimedia and comprehension, van den Broek, Kendeou & White (2009) have found that

the processes and skills in comprehension in different media overlap considerably (and) as a result, multimedia approaches to fostering comprehension have considerable potential, both with regard to comprehending specific information and with regard to developing strategies that can be applied in a range of comprehension situations” (p. 69)

Further, Kamil, Intrator & Kim (2000) posit that electronic storybooks have the potential to support and enhance comprehension due to their stimulation of dual coding/dual processing of material in both verbal and visual formats simultaneously. This dual coding/dual processing results “in a richer and more memorable understanding of the story through the interactive technology” (McKenna & Zucker, 2009, p. 261).
When looking at the importance of learning from multiple channels, in addition to the supports noted above (Kamil, Intrator & Kim, 2000; McKenna & Zucker, 2009), children with language deficits can also be supported more successfully with eBooks within the classroom. In support of Larson’s discussion of e-books’ potential for students with special needs, Bus, Verhallen and deJong’s (2009) work with second language children within the Netherlands have found eBooks to be successful tools in supporting the literacy development efforts of these children. “Consistent with the hypothesis that multiple information sources support language development, we found that children lagging in language skills benefit most from the digitized storybook . . .” (p. 157). They further conclude in a more universal application that children who have limited linguistic luggage – a growing group all over the world – need the intensity of a synergistic intervention as they have fewer background experiences to help them understand the storyline and derive the meaning of unfamiliar words and sentence structures . . . (and that) . . . by organizing classroom routines with onscreen video storybooks as a central element, teachers have a powerful tool at their disposal to treat language deficits – one of the two main sources of reading problems. (p. 163-164)

Learning from multiple channels brings dual coding theory into the forefront. Paivio’s (1986) theory becomes a strategic match with eStorybooks in multiple formats as, in their use, nonverbal information does not ‘use up’ the capacity for storing language in short-term memory but enables children to figure out the meaning of unknown
words and store it in long-term memory. Far from being a distraction, multiple representations of favorite stories help deepen children’s understanding of the text. Multiple deliveries of information, instead of just one, bootstrap development of language, basic skills of decoding and comprehension. (Bus & Neuman, 2009, p. 275)

When considering the unique capabilities in providing scaffolding of a different form it is important to recognize that the new technologies can enhance access to story and provide support for individualized student learning. Labbo (2009) posits that the “multimedia features of electronic books may scaffold children’s independent story comprehension, if they are able to listen to text read aloud, view animations that are cohesively related to story content, and navigate through the page screens by clicking on directional arrows” (p. 199). Bus & Neuman (2009) picture that “electronic scaffolds can look like a computer pal who from time to time interrupts the story to interact with the audience through questions or encouragement” (p. 276). In addition, “multimedia options open an interactive vista that can support children’s literacy development in a digital world and provide them with access to stories that may be beyond their reading level” (DeJong & Bus, 2003, p. 161). The National Association for the Education of Young Children’s Position Statement on Technology (2011) states that “educators must match the technology to each child’s unique special needs, learning styles and individual preferences” (p. 3). This is in support of Gardner (1999) who states that “multiple intelligence theory not only comports with intuitions that children are smart in different ways; it also holds out hope that more students can be reached more effectively if their
favored ways of knowing are taken into account in curriculum, instruction and assessment” (p. 21). Labbo (2003) has proposed that “electronic symbol making may serve as a bridge to conventional literacy for some children” (p. 16). Additionally, Larson (2010) posits that “because e-books can be presented in an individualized format, students with special needs (ELL, visually impaired, struggling readers) may benefit from the additional text tools available with the use of electronic texts” (p. 16).

Electronic storybooks also have the capability to minimize the digital divide and “level the playing field for children from different family backgrounds” (Bus & Neuman, 2009, p. 276) in their ubiquitous nature and no-cost accessibility through entities such as public libraries. Without employing effective strategies to assure access, however, and “active attempts to overcome the knowledge deficit, media influences may further widen the digital divide between children” (Bus & Neuman, 2009, p. 277). Classroom educators can play a key role in both developing these strategies and in assuring access to eStorybooks to all children and families.

In all of these areas, new technologies can also produce motivational environments that prompt student learning in a variety of situations. Clements and Nastasi (1993) found that “one’s motivation, attitudes toward learning and sense of competence are interrelated. The extent to which educational technology provides opportunities for exploration and mastery will influence the extent to which they can contribute to the enhancement of effectance motivation and perception of the self as competent. Computer environments provide such opportunities . . . ” (p. 263). In support of this, DeJong and Bus (2003) found that “interactivity (with CD-ROMs) tended to
enhance children’s engagement and motivation for stories and, in turn, their retention of
the stories’ content” (p. 149). Further, Shamir & Korat (2009) believe that “when
teachers select these materials wisely, and use them to support children’s learning,
eBooks may potentially empower children and motivate them to develop key emergent
literacy skills in the early years” (p. 178).

Blagojevic (2011) quotes Muir in his discussion of the need to be deliberate
about change within our schools as he states that “the focus must always be on children’s
learning and that it is important to use a blended and balanced approach of technology
alongside regular classroom tools” (p. 5). Larson’s (2010) research found that “digital
readers show promise in supporting struggling readers through multiple tools and features,
including manipulation of font size, text-to-speech options, expandable dictionary, and
note capabilities . . . digital readers merge the two media in innovative and interesting
ways” (p. 21-22) as they skillfully blend “the portability of books with the search and
storage capabilities of personal computers” (Goldsborough, 2009, p. 11).

Finally, among all of the above exhortations to integrate electronic storybooks
within classroom literacy instruction, Marsh (2009) encourages educators caught in a
quandary of time and energy to consider that

not to develop these pedagogical approaches . . . is to assign our youngest
children to an education which, although generally successful in preparing
children for encounters with the written word on paper, is not yet as successful in
ensuring they are proficient with the multimodal, multimedia texts and practices
that permeate everyday life in the twenty-first century. (p. 41)
Why should we make time? How to find it? These are monumental priorities if we are to assure children leave our classrooms equipped with the best instruction and opportunities to grow competitively, not only corporately but individually, in the multimodal literacy world that is the twenty-first century and beyond.

Limitations of the Study

Quantitative correlational studies, by their very nature, exhibit a relative weakness in establishing a cause and effect relationship, yet clear relationships may be observed between the variables under study. Even so, internal validity of this study is still considered relatively low due to the lack of controls possible within a study of this design.

The sample size used within this study, though consistent with numbers required within correlational studies, was indeed a small one numbering a total of 32 subjects. Ideally, for more conclusive results, a much larger sample size would have increased perhaps both the validity and reliability of results. This would be a recommendation for future studies of this nature.

Whenever multiple data gatherers are used, in this case and inescapably, the parents/teachers of the students in addition to the researcher, a certain element of validity is lost. No matter how well participants are trained to accurately gather and represent the information at hand, human nature is an unpredictable element that cannot be controlled and compartmentalized.

Though strong and consistent efforts were made by both the researcher and classroom teachers to garner parent responses to an evaluative protocol examining the
accuracy of student intelligence profile data, the rate of return on member check data was not as large as would have been preferred. Only 33% of parents responded to queries concerning the impressions of their child’s individual results on the MIDAS/My Young Child instrument. Teacher response examining the accuracy of student intelligence profile data was registered as average in terms of their views of the parent results from the generated MIDAS student intelligence profiles in comparison to their own beliefs and observations concerning individual student intelligence strengths.

**Summary**

Within the conclusions and implications of this study, I looked at potential extended meanings for some of the data results, as well as the possible implications of these results of the differing classroom environments and instructional philosophies, both singularly as well as in combination. In addition, we looked at these results in relation to unique student intelligence profiles, reader response theory and relationship, the role and importance of teacher as coach/facilitator, the role of story content, dual coding theory, multiple unique paths to literacy, personal life connections to interactive story and the creation of personal plans for story exploration.

I also explored the potential for further study and investigation in areas such as individualized instruction, new literacies, transmedia/multiple platforms and eye tracking and multimedia learning. Where possible divergent meanings and research directions may have been present, the researcher looked at alternative interpretations both within the parameters of the data results and existing research.
All of this was couched within known and presumed limitations of the study itself. Within this context, it is hoped that these extended looks at the data results for individual exemplar students and their implications as well as the combined cross case analysis and similarities viewed across all exemplars as a whole will hopefully not only extend possibilities for the results of this study and their potential applications but also further research within the broader literacy learning tableau.
APPENDICES
APPENDIX A

IRB PARENTAL CONSENT LETTER
APPENDIX A

PARENTAL CONSENT LETTER

Student Interactions With CD-ROM Storybooks: A Look at Potential Relationships Between Multiple Intelligence Strengths and Levels of Interaction

I am interested in doing research on multiple intelligence theory and CD-ROM computer storybooks and would like you and your child to participate in this project. If you decide to do this, you will be asked to participate in a written assessment of your child’s multiple intelligence strengths lasting approximately one half hour in length. Within your child’s classroom, your child will be asked to participate by viewing and interacting with a CD-ROM computer storybook. Both you and your child’s participation will take place during the Spring of 2007.

If you and your child take part in this project, information gathered here will provide data for in depth research in this area. To assure you and your child’s anonymity, pseudonyms and only general descriptive information will be used within the analysis and reporting of research results. You will also receive a copy of the MIDAS/My Young Child assessment results for your child.

Taking part in this project is entirely up to you and no one will hold it against you or your child if you decide not to do it. If you do take part, you may stop at any time.

If you want to know more about this research project, please call me at 440-740-0481, or my advisor, Dr. Timothy V. Rasinski at 330-672-0649. You may also e-mail me at cahuffma@kent.edu. The project has been approved by Kent State University. If you have questions about Kent State University’s rules for research, please call Dr. Peter C. Tandy, Acting Vice President and Dean, Division of Research and Graduate Studies at 330-672-2704.

You will get a copy of this consent form.

Sincerely,

Celia Huffman
Student Researcher

Consent Statement:

I agree to take part and allow my child to take part in this project. I know what I and my child will have to do and that I or my child can stop at any time.

Signature
Date
APPENDIX B

AUDIO/VIDEOTAPING LETTER OF CONSENT
APPENDIX B

AUDIO/VIDEOTAPING LETTER OF CONSENT

Student Interactions With CD-ROM Storybooks: A Look at Potential Relationships Between Multiple Intelligence Strengths and Levels of Interaction

I agree to videotaping of my child’s computer screen at

________________________________________________
on  ________________________________.

________________________________________________
Signature                                                              Date

I have been told that I have the right to see the videotapes before they are used. I have decided that I:

_____ want to see the tapes     _____ do not want to see the tapes

Sign now below if you do not want to see the tapes. If you want to see the tapes, you will be asked to sign after seeing them.

Celia Huffman and other researchers approved by Kent State University may/may not use the tapes made of my child’s computer screen. The original tapes or copies may be used for:

_____ this research project        _____teacher education

_____presentation at professional meetings

________________________________________________
Signature                                                              Date

Address:
APPENDIX C

PARENT MIDAS INFORMATION LETTER -- LONG
APPENDIX C

PARENT MIDAS INFORMATION LETTER -- LONG

3/13/2007

Dear Parent,

Thanks so much in advance for completing the attached MIDAS-MY YOUNG CHILD assessment. Completing this assessment should take no longer than 20-30 minutes.

Attached to the MY YOUNG CHILD document is a computerized answer sheet upon which you can mark your responses to the questions posed. Please place your child’s name, not your own, and sex in the grid provided at the top left of the answer sheet. At the bottom, please list your child’s birthdate. This is the only information needed on the left side of the page.

Please read the attached instructions before beginning. Please be fair to your child; do not under or over estimate what your child can do.

The MIDAS-MY YOUNG CHILD assessment will provide you with a profile of your child within the lens of Howard Gardner’s eight intelligences; musical, kinesthetic, logic/math, spatial, linguistic, interpersonal, intrapersonal and naturalist. As individuals, we each represent a mix of these various intelligences. To quote the MIDAS creator, Dr. C. Branton Shearer, “The purpose of MIDAS is to begin a conversation that will describe each student’s natural intellectual raw materials so that they may be provided with support and challenged to develop these gifts into personally rewarding and meaningful work that is valued within the classroom and their community”.

Thanks again for your participation. Please return these assessments to XXXX by Monday, 4/2/07. You will receive a copy of your child’s profile by the end of May 2007.

Sincerely,

Celia Huffman
Student Researcher
APPENDIX D

PARENT CONSENT COVER LETTER
4/16/2007

Dear Parent,

The attached letters ask for your permission to work with your children in XXXX classroom during late April and May.

I’m interested in studying how children learn differently and how we might help them by using computer storybooks in teaching them how to read. I give you additional information about this in the attached letters.

What will you need to do?
Please sign the attached forms.
At home, you will fill out a questionnaire about your child’s multiple intelligence strengths that will take you about 30 minutes.

What will your Kindergartener need to do?
Enjoy viewing and interacting with a CD-ROM computer storybook at school.

Thanks in advance for helping me with this project by signing the attached forms and returning them to XXXX by Monday, April 23.

Sincerely,

Celia Huffman
Student Researcher
APPENDIX E

LEVEL OF INTERACTION RUBRIC
APPENDIX E

LEVEL OF INTERACTION RUBRIC

LEVEL OF INTERACTION WITH CD-ROM STORYBOOKS RUBRIC

ATTENTIVE/PERCEPTUAL

- Passive viewing
- Clicking (as on animation with no utterances)

CD PROCEDURES

- Navigating through the CD (click on arrow to move to the next screen)
- Planning CD procedures (verbalizing plans on next action)

AFFECTIVE

- Humor
- Sarcasm
- Dramatic (repeating dialogues, sound effects)
- Musical (swaying, Singing)

COGNITIVE

- Labeling
- Describing action
- Wondering
- Providing a summary statement
- Commenting on a character
- Commenting on plot
- Commenting on theme

METACOGNITIVE

- Predicting
- Confirming
- Intratextual connections
- Personal life connections
- Strategic access of media effects
- Misconceptions
APPENDIX F

MIDAS PARENT REFLECTION FORM
APPENDIX F

MIDAS PARENT REFLECTION FORM

___________________________Parent’s Reflection___________________________

Student Name                                                        Date

The areas on the Profile that I think are too high or low are:

<table>
<thead>
<tr>
<th>High</th>
<th>OK</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linguistic</td>
<td>___</td>
<td>___</td>
</tr>
<tr>
<td>Musical</td>
<td>___</td>
<td>___</td>
</tr>
<tr>
<td>Spatial</td>
<td>___</td>
<td>___</td>
</tr>
<tr>
<td>Kinesthetic</td>
<td>___</td>
<td>___</td>
</tr>
<tr>
<td>Logic-math</td>
<td>___</td>
<td>___</td>
</tr>
<tr>
<td>Intrapersonal</td>
<td>___</td>
<td>___</td>
</tr>
<tr>
<td>Naturalist</td>
<td>___</td>
<td>___</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>___</td>
<td>___</td>
</tr>
</tbody>
</table>

Overall, I think the Profile is: OK____ Too high____ Too Low____ Mixed up _____

The _____________________________ scale surprises me because . . .

________________________________________________________________________

The _____________________________ scale puzzles me because . . .

________________________________________________________________________

What I learned about my child by reviewing this assessment is . . .

________________________________________________________________________

________________________________________________________________________

After reviewing the 5 high and low Specific Skills (on page 2 of the profile) with my child, we agree with the following strengths and weaknesses.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses/Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>3</td>
</tr>
</tbody>
</table>

Comments/Questions:
APPENDIX G

TEACHER INTERVIEW PROTOCOL
APPENDIX G

TEACHER INTERVIEW PROTOCOL

TEACHER CLASSROOM TECHNOLOGY INTERVIEW QUESTIONS

1. What is your philosophy of the use of technology within the classroom?

2. What is your philosophy of the use of technology within literacy instruction?

3. How long have you used computers in your classroom?

4. What started it all?

5. What is the ‘structure’ for the use of technology within your classroom?

6. How do you choose software for use within your classroom? What software are you currently using?

7. Using the constructs of the previous question, how do you use/choose web resources for use in your classroom? Name a few sites you’re currently using and how you discovered them.

8. How do you integrate technology within the curricular demands of the Ohio Academic Content Standards?

9. Talk about your greatest professional supports in using technology within the classroom.

10. Do you use classroom volunteers that assist with technology use? If so, how are these folks trained/guided?

11. Discuss the impact and possible influence of the learning styles/preferences/modalities/intelligence strengths of your children in your classroom practice.

12. How have you seen technology work within/among the classroom experiences of the kids…share some positives and negatives.

13. What do you consider the most amazing/exciting thing about children using computers within your classroom?
REFERENCES
REFERENCES


Handbook of Literacy and Technology. (pp. 45-59). Mahwah, New Jersey: Lawrence Erlbaum Associates


